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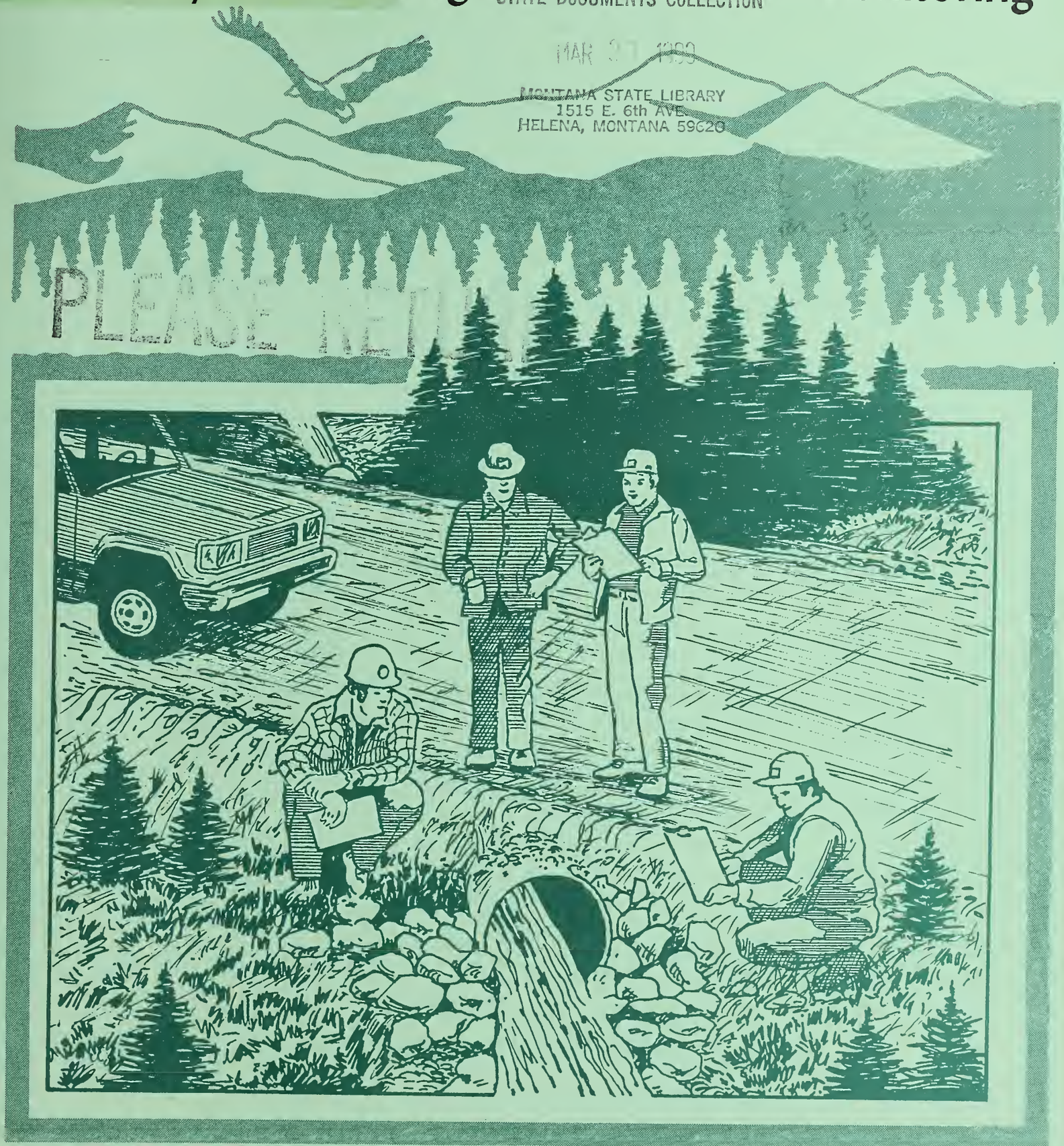

1998 FORESTRY BMP AUDIT REPORT

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FORESTRY BEST MANAGEMENT PRACTICES MONITORING

THE 1998 FORESTRY BMP AUDITS REPORT

This Report Was Partially Funded Through a
Clean Water Act Section 319 Grant, DEQ Contract #2080095

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TABLE OF CONTENTS

PAGE

ACKNOWLEDGMENTS v

EXECUTIVE SUMMARY 1

INTRODUCTION 4

NEW AUDITS

METHODS 6

The Audit Teams 6
The Study Area 7
Site Selection 8
Sample Size 10
The Rating Form 11
Audit Site Inspections 12
Limitations of the Audit Methods 13

RESULTS 14

High Risk BMPs 15
Some Practices Not Rated 16
Application of BMPs 16
Effectiveness of BMPs 20
Cumulative Watershed Effects 22

DISCUSSION 22

Results by Ownership Group 24
Comparison with Previous Audits 24
Streamside Management Zones 28

REAUDITS

INTRODUCTION 31

METHODS 31

RESULTS 32

Case Studies 32

DISCUSSION 38

PAGE

RECOMMENDATIONS FROM AUDIT TEAM MEMBERS 39

REFERENCES 40

APPENDICES

A. Audit Team Members A-1
B. Hazard Matrix B-1
C. Rating Form C-1
D. Rating Flow Chart D-1
E. Audit Sites E-1
F. Audit Results by Individual BMP F-1
G. Reaudit Form G-1

INDEX OF TABLES, FIGURES AND PHOTOS

PAGE

Table 1 Number of Sites Audited by Ownership Group 9

Table 2 Percentage of Sites Meeting High Hazard Criteria 10

Table 3 Harvest Unit Size Evaluated by Ownership 11

Table 4 Application of BMPs to All Rated Practices by Ownership Group and Rating Category 16

Table 5 Application of High Risk BMPs by Ownership Group and Rating Category 17

Table 6 Audit Sites with Departures from BMP Application and Average Number of Departures per Site 19

Table 7 Effectiveness of BMPs for All Rated Practices by Ownership Group and Rating Category 20

Table 8 Effectiveness of High Risk BMPs by Ownership Group and Rating Category 21

Table 9 Audit Sites with Impacts and Average Number of Impacts Per Site 21

Table 10 Comparison of BMP Audit Results--1998 vs. 1996, 1994, 1992 and 1990 . . . 25

Table 11 SMZ Departures by Ownership Group 29

Table 12 SMZ Departures by Practice 30

FIGURES

Figure 1 Audit Sites Location Map 7

Figure 2 BMP Application--All versus High Risk 18

Figure 3 Percentage of Related Practices Resulting in Impacts 20

Figure 4 Comparison of BMP Application 26

Figure 5 Comparison of BMP Effectiveness 26

Figure 6 Sites with Major Departures or Impacts 27

PAGE

FIGURES (Continued)

Figure 7 Average # of Departures per Site 27

Figure 8 Average # of Impacts per Site 28

Figure 9 Percent of Sites w/at Least One SMZ Departure 29

PHOTOS

Photo 1 West Audit Team Evaluating Road Run-off 7
(Photo by Tim Wiersum NRCS)

Photo 2 West Audit Team Evaluating Harvest Unit 13
(Photo by Tim Wiersum NRCS)

Photo 3 Central Audit Team Evaluating Road Drainage Features 14
(Photo by Pam Hackley, OEA)

Photo 4 Northwest Team Filling Out Rating Form 15
(Photo by Pam Hackley, OEA)

Photo 5 Eastern Audit Team at a Pre-Audit Meeting 17
(Photo by Pam Hackley, OEA)

Photo 6 Eastern Audit Team Explaining Audit to Landowner 18
(Photo by Ken Spencer, AG Almanac)

Photo 7 Central Audit Team Evaluating Temporary Bridge Stream Crossing 19
(Photo by Gary Frank, DNRC)

Photo 8 Northwest Audit Team Evaluating SMZ 28
(Photo by Gary Frank, DNRC)

Photo 9 Skid Trail 30
(Photo by Tim Wiersum NRCS)

ACKNOWLEDGMENTS

In 1998 the Service Forestry Bureau, Forestry Division of the Montana Department of Natural Resources and Conservation once more undertook the task of completing the Forestry BMP audits. The Division gratefully acknowledges the many people who gave their time and energy toward this audit effort. Special thanks go to the work group members who contributed to the task of reviewing the many issues that arose from the 1998 audits as well as overseeing the entire process, and to the audit team members who traveled extensively, worked long days in the field, and made many difficult decisions in a professional manner. Thanks also go to the Environmental Quality Council and Governor's office, to all who supplied information to select the sites, and to those who gave access to private lands. The Department would like to thank Pam Hackley and Deb Massett of OEA Research Inc., who accomplished a variety of services throughout the audit process under a DNRC contract. Our thanks also go to George Mathieus and Kit Sanger for their assistance. Special thanks go to Patty Fish and Kate Kronen for creating and editing portions of this report. Thanks also go to Mira Bruner for her assistance with all the mailing. The Department would like to thank all those individuals who supplied photos for this report. Finally, DNRC appreciates the EPA and DEQ for funding and facilitating the grant that covered some of the audit expenses.

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EXECUTIVE SUMMARY

The Best Management Practice (BMP) audit process is used to evaluate whether BMPs are being applied and if they are effective at limiting non-point source pollution. The Governor has requested the Montana Department of Natural Resources and Conservation (DNRC), Forestry Division to evaluate forest practices for BMP implementation and report the findings to the EQC. This report summarizes the findings of Montana's 1998 forestry BMP audits, and complements similar study reports completed in 1990, 1992, 1994 and 1996.

Four interdisciplinary teams conducted the audits. Each team was composed of a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, a soil scientist, and a non-industrial private (NIP) landowner or logging professional. DNRC used site selection criteria to choose 47 new timber harvest sites harvested since 1996. The selection criteria limited the sample to those sites most sensitive to the practices that affect water quality. The audit teams evaluated up to 46 practices at each site, rating application and effectiveness for each BMP on a 5-point scale. For the first time, 11 sites previously audited in 1994 or 1996 were evaluated to determine if BMPs are effective over time.

The audit teams evaluated 47 sites for **BMP application.** Audit results showed that 94% of the time BMPs were properly applied. The application of eight high risk BMPs was evaluated separately because they are among those most important for protecting soil and water resources. Eighty-four percent of these high risk BMPs were properly applied.

The audit teams also evaluated **BMP effectiveness**. Audit results showed that 96% of the individual practices audited were effective in protecting soil and water resources. Almost half of the sites had some minor departures in BMP effectiveness. Minor departures in effectiveness produce minor impacts to soil and water resources. Seventeen percent of the sites had major departures in BMP effectiveness. Eighty-nine percent of the eight high risk BMPs evaluated were rated as providing adequate protection to soil and water resources.

The greatest departures from BMPs, and the most impacts, were associated with road maintenance and drainage. The text includes a list on page 23 of problematic BMPs and BMPs that are usually applied properly.

The audit teams also evaluated application and implementation of the Montana Streamside Management (SMZ) Law. There were 15 SMZ departures noted during all the audits. Most of these were minor and produced no discernible impacts to soil and water resources.

Summary of BMP and SMZ Application and Effectiveness, by Ownership Group

PRACTICE	DNRC	Federal	Industrial	NIP
BMP APPLICATION	96%	92%	95%	94%
BMP EFFECTIVENESS	99%	95%	95%	96%
SMZ APPLICATION	96%	96%	98%	94%
SMZ EFFECTIVENESS	100%	98%	100%	100%

Similar audits were conducted in 1990, 1992, 1994 and 1996 which can be compared to the 1998 results. The 1998 audits show improvement in the application and effectiveness of BMPs when compared with the 1990, 1992, 1994 and 1996 results. These comparisons are summarized below:

Comparison of BMP Audit Results - 1998 vs. 1996, 1994, 1992 and 1990

	1998	1996	1994	1992	1990
Application of practices that meet or exceed BMP requirements.	94%	92%	91%	87%	78%
Application of high risk practices that meet or exceed BMP requirements.	84%	81%	79%	72%	53%
Number of sites with at least one major departure in BMP application.	8 of 47 (17%)	12 of 44 (27%)	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average number of departures in BMP application, per site.	2.0	3.0	3.9	5.6	9
Number of practices providing adequate protection.	96%	94%	93%	93%	80%
Number of high risk practices providing adequate protection.	89%	86%	83%	77%	58%
Number of sites having at least one major/temporary or minor/prolonged impact.	12 of 47 (26%)	15 of 44 (34%)	13 of 46 (28%)	17 of 46 (37%)	28 of 44 (64%)
Average number of impacts per site.	1.5	2.3	3	4.6	8

Recommendations from 1998 Audit Team Members

Audit team leaders, team members and the audit working group met on October 15, 1998, and discussed the audits just completed. Others who could not attend submitted verbal or written comments in advance. The recommendations that follow are preliminary outcomes of that meeting. The BMP audit working group will meet this winter and make final recommendations to continue to make the audits as beneficial as possible.

- Continue conducting interdisciplinary forestry BMP audits every two years -- keep the process "non-regulatory".
- Continue to evaluate implementation of the SMZ law and rules.
- Refine the process and form used to audit previously audited sites.
- Continue to encourage audit site landowner, logger and others to attend the audits.
- Continue to make the process as positive and non-threatening as possible.
- DNRC should commit to designing an audit process that is timely, accurate and efficient. Areas for improvement include: solicitation of team members and audit site information; site selection process; and the timeliness of landowner and team notification of audits.
- Revisit the 2-week limit on notification of audit sites
- Continue a separate calibration training for east & west side teams. Calibration training improvements needed include: strictly regimented field trip; training on doing the re-audits; and perhaps separated procedural training for new team members. Team leaders should attend both training sessions.
- Clarify BMP and audit terminology for more consistent audit interpretations and ratings.
- BMP practices should not be rated when features constructed by the audited party have been altered by a third party.
- Encourage development and use of BMPs, and BMP audits for other land uses. (Not part of October 15th meeting discussion)
- Direct education and persuasion toward BMP practices and/or ownership groups that have the greatest opportunity for improvement.
- Secure a permanent source of funding for the audits.

INTRODUCTION

The forest lands of Montana form the headwaters for several major river basins and produce large quantities of high quality water. This water nurtures some of the West's best fisheries, and is used for irrigation and livestock, as well as for domestic, recreational and industrial purposes. These same lands supply the logs that sustain the forest products industry, an important component of Montana's economy. All products from Montana's 22.5 million acres of forest land contribute in an essential manner to Montana's economy and way of life.

Montana's water quality protection program for forestry involves a combination of regulatory and non-regulatory approaches. Since the 1970's, non-regulatory Forestry Best Management Practices have provided guidance as minimum water quality protection standards for forestry operations.

The BMPs, if properly applied, can limit non-point source pollution--the kind of diffuse pollution that forestry operations often produce, such as sediment from a road or timber harvest. The BMP audit process is used to evaluate whether BMPs are being applied and if they are effectively limiting non-point source pollution.

Concern over the impacts of forest management on Montana's watersheds prompted the 1987 Montana Legislature to pass House Joint Resolution 49. This resolution directed the Montana Environmental Quality Council (EQC) to study "how current forest management practices are affecting watersheds in Montana" (Zackheim, 1988). The EQC established a BMP technical committee that developed Montana's forestry BMPs in 1989.

Prior to 1990, forestry water quality was addressed through a voluntary approach. In 1989, the Legislature enacted the BMP Notification Law (76-13-101 MCA) which requires private landowners who plan to harvest timber to notify the state of their plans. Under this law, forestry BMP information is sent to landowners. Implementation of practices is voluntary. DNRC Service Foresters review a limited number of high risk sites prior to timber harvest. Private land sites reviewed during the 1998 audits were subject to the BMP Notification Law.

Since October 1991, the Streamside Management Zone (SMZ) Law (77-5-301 MCA) regulates forestry practices along streams. This law prohibits certain forest practices along stream channels. The SMZ rules, which were mandated by the law, became effective March 15, 1993 and were intended to help define and clarify the SMZ law. The 1992 BMP audits did not evaluate compliance with the SMZ law because most operations audited were completed prior to the effective date of the law. Beginning in 1994, however, the audits were designed to provide preliminary information on the application and implementation of the SMZ law and rules, using a supplemental SMZ questionnaire.

In 1998, the format used to evaluate the SMZ law and rules was the same as the one used to evaluate the BMP's for application and effectiveness on a 5-point scale. DNRC's intent was to supply data that would be more easily summarized.

Forestry BMP audits have been conducted previously in Montana. As part of HJR-49, audit teams conducted the first statewide assessment of forest practices for BMPs during the summer of 1988 (Zackheim, 1988). In 1989, the University of Montana, under the Flathead Basin Water Quality and Fisheries Cooperative, audited more sites for BMPs in the Flathead River drainage (Ehinger and Potts, 1990). The Montana Legislature directed DNRC to conduct further series of statewide BMP audits in 1990, 1992, 1994 and 1996 (Schultz, 1990 and 1992; Frank, 1994; Mathieus, 1996).

In 1995 the Governor requested the Montana Department of Natural Resources and Conservation (DNRC) Forestry Division to once again evaluate forest practices for BMP implementation and report to the EQC before the 1997 legislative session. This report summarizes the findings of Montana's 1998 forestry BMP audits.

The BMP audit process, which the EPA calls BMP implementation monitoring, is a widely-used means of evaluating forest practices. Implementation monitoring is a surrogate for water quality monitoring, a more quantitative approach. Water quality monitoring is a long-term and expensive endeavor. Water quality varies naturally due to variable geology, land forms, soils, and climatic events. Due to this variability, investigators have to collect large numbers of samples at the right time and over a long period of time to accurately characterize water quality.

Investigators use qualitative implementation audits to find out if BMPs are being applied and whether they are controlling erosion; they can use quantitative water quality monitoring to determine if BMPs are protecting beneficial water uses. Since BMPs are recognized by state and federal legislation as a method to control non-point source pollution, it makes sense to check the application and effectiveness of BMPs as part of such a program. States are increasingly relying on qualitative surveys, using interdisciplinary teams to assess forest practices on-site, to monitor their silvicultural non-point source control programs (NCASI, 1988). California, Idaho, Oregon, Utah, Minnesota, Washington, South Carolina, Texas and Florida all use a similar qualitative approach to assess the control of non-point source pollution from forest practices.

A technical work group oversees the BMP process and provides recommendations to DNRC. The work group members represent a broad range of interests in forestry in Montana. Several members have been with the program since 1988, including serving on the audit teams.

In addition to evaluating recently harvested sites for the 1998 cycle, previously- audited sites were evaluated to examine the long-term effectiveness of BMPs. This was considered a "pilot project" and is reported in the second half of the report as "Reaudits."

NEW AUDITS

METHODS

BMP audits have been conducted every two years starting in 1990; 1998 represents the fifth cycle. The 1998 audits were conducted with similar objectives and criteria as the previous audits in order to produce comparable results.

In 1998, the objectives of the BMP field audits were to:

1. Determine if BMPs are being applied on timber harvest operations.

2. Evaluate the general effectiveness of BMPs in protecting soil and water resources.

3. Provide information on the need to revise, clarify, or strengthen BMPs.

4. Provide information to focus future educational or study efforts by identifying subjects and geographic areas in need of further attention or investigation.

5. Provide information on the implementation of the SMZ law and rules and evaluate general effectiveness of SMZ's in protecting water quality.

As in the past, DNRC sought a broad range of participation in planning the 1998 audits.

The Audit Teams

Previous to 1998, three audit teams conducted the audits, each having six members. In 1998 DNRC designated four audit teams--one each for the northwestern, western, central, and eastern parts of the state. The fourth team was added to accommodate the additional workload associated with the reaudits. The 1998 teams had seven members--a fisheries biologist, forester, hydrologist, conservation group representative, road engineer, soil scientist, and the newly-added shared position of logging professional or non-industrial private landowner (NIP). A member of each audit team was assigned to lead the team. The team leader was responsible for filling out the rating form and for overseeing the logistics of the team. Team members were employees of federal and state agencies, private industry, independent consultants, conservation organizations or volunteers. Several newly retired individuals returned to represent their specialty just for these audits. The Department of Natural Resources and Conservation received a 319 grant from the EPA in part to pay or reimburse members who were not able to participate as a part of their regular job.

Although continuity in team membership was favorable, the addition of a fourth team made securing enough participants difficult. Professionals' participation was solicited, and a large pool of team members developed to ensure a high degree of continuity for future audits. Sixty-six people were available to serve as team members; 43 had previous audit experience. Several new faces were welcomed to the process and DNRC looks forward to having them on future audits.

See Appendix A for a complete list of team members.

Photo #1. West Audit Team Evaluating Road Run-Off

The Study Area

The Department expanded the study area to include the eastern half of the state in the 1994 audit, and has continued to do so through the 1998 audits. During the 1990 and 1992 audits

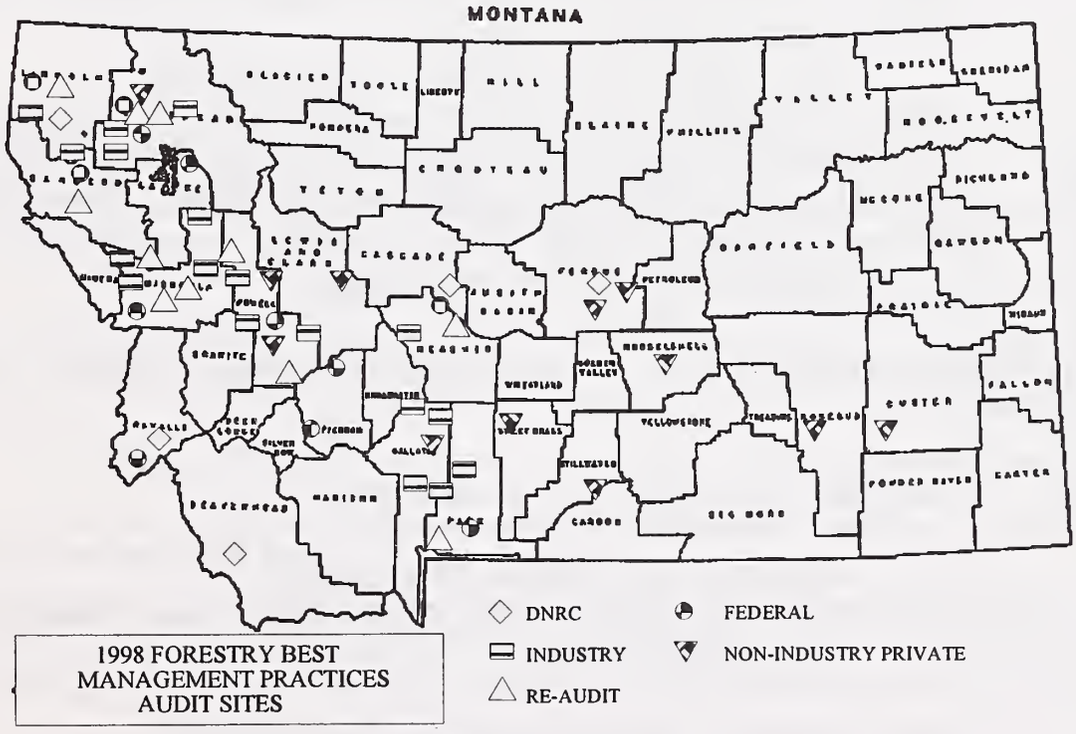


Figure 1. Audit Site Location Map

the study area was limited to the western half of the state, where a majority of the timber harvest had occurred. Since that time, there has been a substantial increase in the volume of timber harvested in eastern Montana. Approximately half of the statewide non-industrial private harvest volume in 1996 came from east of the Continental Divide (the latest figures available at the time the of audit site selection).

Site Selection

Selecting audit sites was accomplished by a DNRC contractor.

The criteria for selecting sites were similar to the previous audits. The criteria were defined so as to concentrate on sites that were more likely to have the potential for water quality impacts. **The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality.**

The initial site selection criteria were:

- Sites were selected from areas with timber harvested in 1996, 1997, or 1998. Priority was given to the most recently harvested sites.

- A portion of the sale needed to be located within 200 feet of a stream.

- The harvest units were five acres or greater. The target timber harvest volume removal was 5 thousand board feet (MBF) per acre or greater for west side units and at least 3 MBF for east side units.

- The geographic distribution of audit sites reflects the distribution of timber harvest ownership group.

- Sites were classified into four land ownership classes—Non-industrial Private (NIP), Industrial Private (IND), Federal (FED), and State (DNRC). The number of sites for each ownership group was proportional to the volume of timber each group harvested in 1996, the latest complete reporting period. A minimum of five sites per ownership class were audited.

For sites that met the initial criteria, further stratification was made to maximize the number of BMP's evaluated:

- First priority was given to sites which had:

    1. Harvesting within 200 feet of a stream,
    2. Road construction or reconstruction with a stream crossing, and
    3. Slash disposal completed.

- Sites with streams adjacent to harvesting, road construction or reconstruction, but with slash disposal not complete, were given second priority.

- Sites with a stream adjacent to harvesting with slash disposal complete, but no road construction or reconstruction, were given third priority.

Additional considerations went into final site selection:

- Sites were further stratified by erosion hazard potential. The target was to have two-thirds of the audits located on high erosion hazard sites and one-third located on low to medium erosion hazard sites. This stratification was subject to the availability of sites in the various hazard groups. Erosion hazard was further stratified by ownership so that a disproportionate number of high hazard sites did not fall in any one ownership class. Erosion hazard was determined using the Montana Riparian Association erosion hazard matrix (see Appendix B). The relative hazard is a function of slope, soil erosivity, type of timber harvest and soil texture.

- When more than one site met the above criteria, the site most efficiently accessed relative to the location and schedule of other audit sites was selected.

These audit results DO NOT represent a sample of all timber harvest operations in Montana--ONLY those meeting site selection criteria.

As in the past, the goal was to audit at least 45 new sites. Forty-seven new sites were audited, along with 11 re-audits. Team member availability limited the number of sites each team could visit. The maximum time commitment for audit team members was 10 days, since a longer commitment would jeopardize individuals' ability to participate. Teams audited one or two sites per day.

Table 1
Number of Sites Audited by Ownership Group

Ownership Group	1998	1996	1994	1992	1990
DNRC	5	5	5	5	5
Federal	12	12	14	16	16
Industrial	18	14	14	16	16
NIP	12	13	13	9	7
Total	47	44	46	46	44

See Appendix E for the list of sites.

The volume harvested on State lands was low in comparison to other ownership groups. By strict apportioning, there would have been only one to two state land sites. However, since the criteria apportioned a minimum of five sites per owner group, five state sites were audited.

The State's harvest was then subtracted from the total and the remaining 40 sites apportioned between the remaining four ownership groups.

Table 2 shows the percentage of audited sites that met the high hazard criteria. Over two-thirds of the sites audited were high hazard. This is comparable to previous audits.

Table 2
Percentage of Sites Meeting High Hazard Criteria

Ownership Group	Number of Sites	Matrix	Riparian	Matrix, Riparian or Both
DNRC	5	60%	20%	6[illegible]%
Federal	12	67%	42%	67%
Industrial	18	78%	61%	83%
NIP	12	50%	42%	6[illegible]%
All Sites	47	66%	47%	68%

Members of all the ownership groups were very cooperative and provided essential information to DNRC and its contractor. DNRC requested information about recent timber sales from private industry with fee land holdings in Montana, from the National Forests, and from BLM. These agencies searched their recent timber sales for sites that met some or all of the criteria. For non-industrial lands, DNRC searched Hazard Reduction Agreements for sites that met the criteria. DNRC searched its own timber sale accounting program for state sites that met the criteria.

For non-industrial private landowners, DNRC made the initial contact to request permission to visit their sites. DNRC supplied the contractor with available information from the initial screening process. Follow-up contacts by the contractor requested additional information and made site visit arrangements. After the DNRC contractor contacted non-industrial landowners, a follow-up letter was sent to each landowner explaining the purpose of the audits and DNRC's policy toward enforcement actions. Participation by NIP landowners was very high. Access to the other ownership groups was not an issue.

Sample Size

The size of audited sites varied greatly. Table 3 contains information on harvest unit size by ownership group. On very large sites, time did not allow the teams to review every acre of the site or every segment of new or existing roads. Teams selected where, within the audit unit, the audit would be done prior to the actual entry into the harvest unit. Teams selected specific areas with the greatest potential for problems. Selection was made using maps and some discussion with landowners or their representative.

Table 3
Harvest Unit Size Evaluated by Ownership

Ownership Group	Number of Sites	Average Unit Size (Ac.)	Maximum Unit Size (Ac.)	Minimum Unit Size (Ac.)
DNRC	5	65	139	4
Federal	12	40	242	7
Industrial	12	82	385	5
NIP	12	53	160	10
All Sites	47	60	385	4

Because the total number of cutting units in the state is unknown, the sample size percentage represented by the 47 sites is also unknown. It is representative of logging units completed since 1996 that meet the selection criteria. The results are indicative of conditions on sites with potential to impair water quality. The 47 sites represent less than 1% of the total volume harvested for the period studied.

The Rating Form

The audit teams used a rating form similar to that of previous audits. The form was revised to reflect BMP revisions completed in December 1997. The revisions made kept the format consistent with past audit forms. The guide for rating application and effectiveness was the same as that used in previous audits. The audit teams evaluated up to 46 BMP practices and 10 SMZ practices at each site. The rating of application and effectiveness for each was done on a 5-point scale, as in the past. See Appendix C for a copy of the form. **Current BMPs are available from DNRC Forestry Division offices statewide.**

The audit team rated the application of BMPs by first noting if the BMP was applicable to the site, and if so, whether it was applied correctly and in the proper locations. The audit teams used a flow chart or decision tree to help rate application and effectiveness (see Appendix D).

Lack of adequate application or misapplication were rated as departures from the BMPs. The rating guide for the application of BMPs was:

5 - Operation exceeds requirements of BMP.
4 - Operation meets requirements of BMP.
3 - Minor departure from intent of BMP.
2 - Major departure from intent of BMP.
1 - Gross neglect of BMP.

The following description of the rating guide is adapted from Ehinger & Potts, 1990. Ratings of 5 and 4 are self-explanatory. The 3 rating is a minor departure of small magnitude distributed over a localized area, or over a larger area where potential for impact is low. The 2 rating is a major departure of large magnitude or BMPs being repeatedly neglected. The 1 rating, gross neglect, applies where risks to soil and water resources were obvious with no evidence that operators applied BMPs to protect the resources.

The effectiveness rating answers the question, "Has the application or misapplication of a particular forest practice increased the likelihood of, or actual occurrence of, sediment delivery to streams?" Lack of effectiveness results in impacts.

The rating guide for effectiveness was:

5 - Improved protection of soil and water resources over pre-project condition.
4 - Adequate protection of soil and water resources.
3 - Minor and temporary impacts on soil and water resources.
2 - Major and temporary, or minor and prolonged, impacts on soil and water resources.
1 - Major and prolonged impacts on soil and water resources.

The work group defined these terms prior to the 1990 audits to help the audit teams use them consistently:

Adequate--Small amounts of material eroded; material does not reach draws, channels, or floodplain.
Minor--Some material erodes and is delivered to draws but not to stream.
Major--Material erodes and is delivered to stream or annual floodplain.
Temporary--Impacts lasting one year or less; no more than one runoff season.
Prolonged--Impacts lasting more than one year.

Audit Site Inspections

Two training sessions were conducted prior to the actual audits; one for the west and northwest teams and one for the central and east side teams. This session served as a refresher to those with previous experience and as a calibration to the new team members. All team members, including alternates, were strongly encouraged to attend one of these sessions. The goal was to create rating consistency among all teams. The training gave several hours of classroom instruction on the BMP audit process and then evaluated a mock audit site in the field. Team members shared results and identified and discussed their differences and ways to be consistent.

Photo #2. West Audit Team Evaluating Harvest Unit.

Audits were conducted in July and August of 1998. The field routine consisted of meeting at a central location in the morning and traveling together to the vicinity of the first audit. Once in the vicinity but not yet at the audit site, the team leader provided maps and audit forms. Usually a representative of the landowner briefed the team by giving background information on the silvicultural prescription, time of operation, and associated practices. This is where the final decision was made on which roads and harvest unit would be audited. Team members walked the site, reviewing potential impact areas such as roads, streams, SMZ's, skid trails and firelines. Teams typically spent about two hours inspecting each site.

After inspection, the team gathered and rated the site while still on site. The team leader led the discussion and recorded the consensus for each rated practice. When the team could not reach a consensus, a majority vote was taken. The team leader noted dissenting values in the Comments section. Teams almost always reached a consensus. Many observers attended the audits and gave feedback when requested but were not allowed to participate in the rating or to "lobby" for a particular score.

Limitations of the Audit Methods (in part adapted from Idaho DHW, 1989.)

In analyzing the audit results, readers need to consider the limitations of the audit techniques. The audits are a one-time field inspection and assessment. They document erosion and sedimentation problems occurring in the first or second year after harvest. This is generally a critical period for erosion after timber harvests. Some practices cannot easily be evaluated in post-harvest audits. Assessments are based on visual appraisals of practices and impacts to surface soils and streams. The results are a "snapshot in time" of the practices and subsequent impacts. They do not necessarily reflect future impacts.

Sites were split among four teams. Although rating inconsistency between teams should not be discounted, it is probably minor due to interaction between teams and the continuity of experienced team members. DNRC monitors each team to help ensure consistency.

Teams may rate several practices connected with one action, and so one action may result in more than one rating. For example, if a skidder operates extensively in the Streamside Management Zone, the practice may rate poorly under both "Adequate SMZ Maintained" and "Equipment Operation Minimized in SMZ." Even given these limitations, the BMP audit process is an effective way to evaluate the implementation of BMPs. In addition, the audit process has helped promote BMPs and encourage landowners and operators to protect water quality on managed forests.

Photo #3. Central Audit Team Evaluating Road Drainage Features

RESULTS

The results of the 1998 BMP field audits include:

1. Application of BMPs and SMZs;
2. Effectiveness of BMPs and SMZs;
3. A supplemental question on cumulative watershed effects;
4. The SMZ law and rules evaluation; and
5. Comparison of the 1998 results with previous audit results.

There are several ways to analyze and summarize the data generated by this study. One way is to look at what percent of the practices audited for BMPs fell into each rating category, by ownership group. These percentages for application and effectiveness of BMPs are in Tables 4 and 7 respectively. This is useful information for documenting problem BMP areas and

comparing with other audits. Appendix F tabulates how the ownership groups complied with each BMP.

All the practices evaluated can affect water quality, but their potential impacts vary greatly. For example, BMPs in the "Road Planning and Location" section do not have as direct a potential impact on water quality as the practices in "Providing Adequate Road Surface Drainage" or "Installation of Stream Crossings." There is also a somewhat different purpose in auditing BMP practices compared to SMZ activities. They both are designed to protect water quality. However, auditing SMZ law activities is a non-regulatory look at SMZ law compliance, whereas BMPs are, by definition, non-regulatory.

Photo #4. Northwest Audit Team Filling Out Rating Form

High Risk BMPs

Simple percentages alone will not give a clear picture of how well or poorly Montana's watersheds are being protected. Even a low percentage of misapplied BMPs can still result in serious impacts. Therefore, eight high risk BMPs have been analyzed separately. They are among the most important for protecting Montana's watersheds. They include:

BMP Number	Practice Description
III.C.1	Provide adequate road surface drainage for all roads.
III.C.6	Route road drainage through adequate filtration zones before entering a stream.
III.D.2	Stabilize erodible soils (i.e., seeding, benching, mulching).

III.E.2	Maintain erosion control features (dips, ditches and culverts functional).
IV.A.5	Design and locate skid trails to avoid concentrating runoff.
IV.B.5	Adequate drainage for temporary roads, skid trails, fire lines.
IV.C.8	Limit water quality impacts of prescribed fire.
V.C.4	Prevent erosion of culvert and bridge fills (i.e., armor inlet and outlet).

The results for application and effectiveness of the eight high risk BMPs is presented in Tables 5 and 8, and Figure 2. Tables 6 and 9 summarize the data by site, displaying the percent of sites with departures or impacts and the average number of departures or impacts per site.

Some Practices Not Rated

The number of practices rated was 78% of the total possible number of practices. Some BMPs did not apply to a site. For instance, some sites did not have stream crossings or new road construction; most sites did not have borrow pits; or slash disposal and site preparation may not have been completed. In other cases, the audit team could not rate the BMP at the time of the audit--BMPs having to do with timing of operations during the harvest cannot be judged post-harvest.

Application of BMPs

The application rating measures whether the BMP was applied, whether it was applied correctly, and whether it was applied in the proper locations. See "The Rating Form" section on pages 11 and 12 for further explanation of the application rating. The audit teams evaluated a total of 1,682 practices to assess how landowners and operators applied BMPs and SMZ practices. Table 4 lists the percentage of practices that fell in each application rating category, by ownership group. Also refer to Tables 5, 6, 7 and 9 for a more complete indication of how well Montana's watersheds are being protected.

Table 4
Application of BMPs to All Rated Practices
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	# Practices Rated	Meet or Exceed	Minor Departures	Major Departures	Gross Neglect
DNRC	203	96%	4%	0%	0%
Federal	425	92%	6%	2%	0%
Industrial	662	95%	4%	<1%	<1%
NIP	392	94%	5%	<1%	0%
All Sites	1,682	94%	5%	<1%	<1%

Photo #5. Eastern Audit Team at a Pre-Audit Meeting

Table 5 shows the application percentages for the eight high risk BMPs. The percent of practices with departures is higher for the high risk group compared to all audited practices, as shown in Figure 2.

Table 5
Application of High Risk BMPs
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	# Practices Rated	Meet or Exceed	Minor Departures	Major Departures	Gross Neglect
DNRC	39	90%	10%	0%	0%
Federal	86	79%	14%	7%	0%
Industrial	129	84%	15%	<1%	0%
NIP	79	85%	11%	4%	0%
All Sites	333	84%	13%	3%	0%

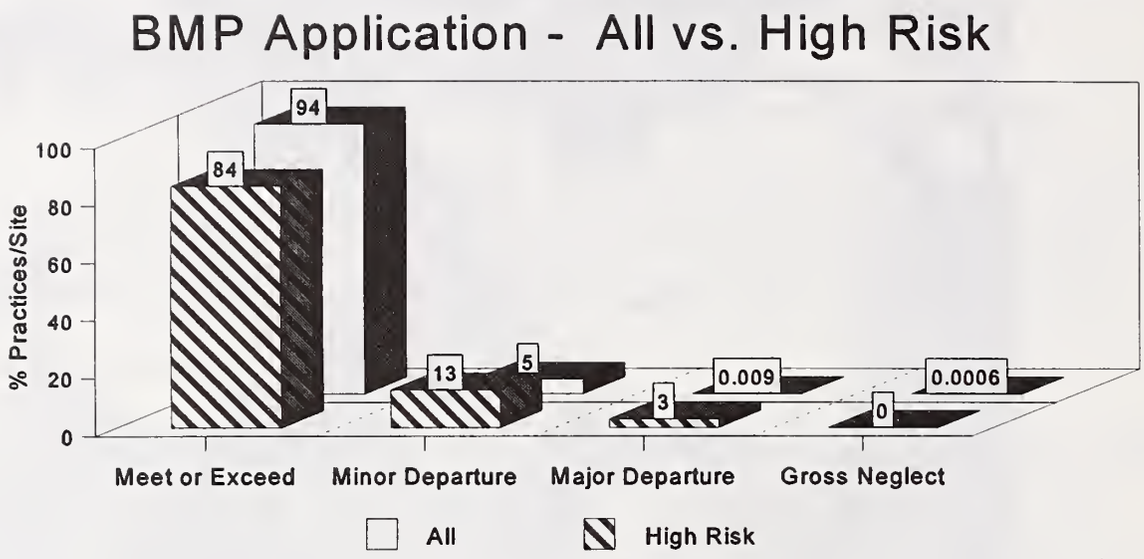


Figure 2.

Photo #6. Eastern Audit Team Explaining Audit to Landowner

Table 6 shows the percentage of sites with BMP departures and the average number of departures per site. Average departures per site is total departures divided by total sites (47). Table 6 shows that 68% of the sites (32 of 47) had at least one minor departure. It also shows that 17% of the sites (8 of 47) have at least one major departure in BMP application.

Table 6
Audit Sites with Departures from BMP Application and Average Number of Departures per Site

		Percentage (%) of Sites with Departures*			# of Departures/Total # of Sites = Ave. #/Site		
Ownership Group	Total # of Sites	Minor	Major	Gross	Minor	Major	Gross
DNRC	5	80%	0%	0%	1.6	0	0.00
Federal	12	92%	42%	0%	2.1	.66	0.00
Industrial	18	50%	5%	5%	1.5	.27	0.06
NIP	12	67%	17%	0%	1.6	.25	0.00
All Sites	47	68%	17%	2%	1.7	.34	0.02

* Each category of departures must be considered separately since a site may have departures in more than one category

Photo #7. Central Audit Team Evaluating a Temporary Bridge Stream Crossing

Effectiveness of BMPs

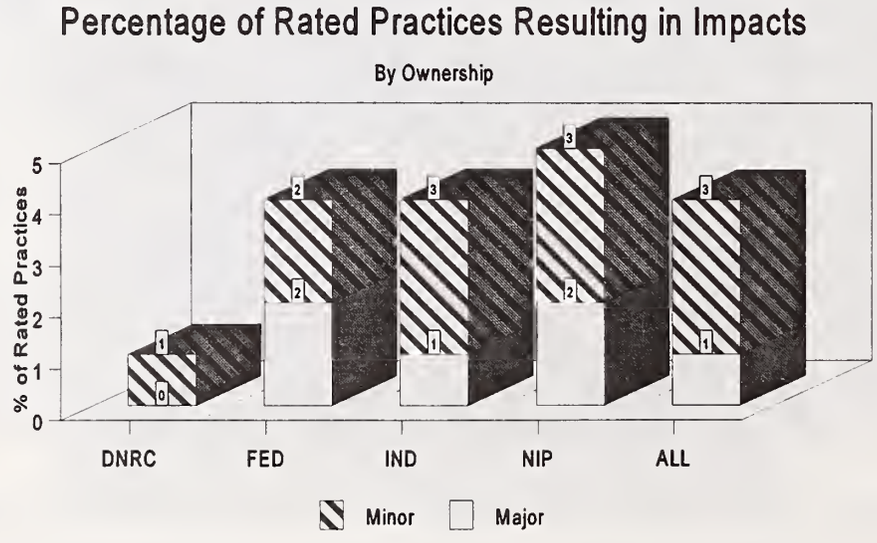
The effectiveness rating evaluates how well BMPs protect soil and water resources. See page 12 for explanation of the effectiveness rating. The audit teams evaluated the effectiveness of 1,682 practices. Table 7 is a summary of practices effectiveness by ownership group.

The effectiveness information in Table 7 should be contemplated with discretion. A simple percentage may be high for "Adequate Protection," yet poor effectiveness of a single BMP may result in significant impacts. Recognizing that possibility, however, does not detract from the significant achievement that 96% of the practices audited adequately protected water quality.

Table 7
Effectiveness of BMPs for All Rated Practices
by Ownership Group and Rating Category

		Percentage (%) Practices Rated As			
Ownership Group	Number of Practices Rated	Adequate Protection	Minor/Temp. Impacts	Major/Temp., Minor/ Prolonged	Major/ Prolonged
DNRC	203	99%	1%	0%	0%
Federal	425	95%	2%	2%	0%
Industrial	662	99%	3%	1%	<1%
NIP	392	96%	3%	2%	<1%
All Sites	1,682	96%	3%	1%	<1%

Figure 3 presents the percentage of practices that had impacts. This also shows the relative effectiveness of BMP implementation among ownership groups.



"Major" and "minor" are defined on page 12.
Figure 3

Table 8 shows the effectiveness of the eight high risk BMPs listed on pages 15 and 16. The percent of practices providing adequate protection is lower for the high risk BMPs than for all BMPs rated. The percent of practices resulting in impacts are also higher.

Table 8
Effectiveness of High Risk BMPs
by Ownership Group and Rating Category

Ownership Group	Number of Practices Rated	Percentage (%) Practices Rated As			
		Adequate Protection	Minor/Temp. Impacts	Major/Temp., Minor/ Prolonged	Major/ Prolonged
DNRC	39	100%	0%	0%	0%
Federal	86	86%	5%	0%	0%
Industrial	129	87%	11%	2%	0%
NIP	79	90%	4%	0%	0%
All Sites	333	89%	6%	5%	0%

Table 9 lists the percentage of sites with impacts and average number of impacts per site. Forty-nine percent of the sites had minor/temporary impacts; on average, 1.0 per site. Twenty-six percent of all sites were producing major/temporary impacts; on average, 0.51 per site. The percentage of high risk practices providing adequate protection was quite high (89%), but impacts were still occurring on almost half of the sites.

Table 9

Audit Sites with Impacts and Average Number of Impacts per Site

Ownership Group	Total # of Sites	Percentage (%) of Sites w/out Impacts	Percentage (%) of Sites with Impacts			# of Impacts/Total # of Sites = Ave. #/Site		
		Adequate or Improved Protection	Minor/ Temp.	Major/Temp., Minor/ Prolonged	Major/ Prolonged	Minor/ Temp.	Major/Temp. Minor/ Prolonged	Major/ Prolonged
DNRC	5	60%	40%	0%	0%	.6	0.00	0
Federal	12	25%	67%	50%	0%	.9	.83	0.00
Industrial	18	56%	44%	11%	6%	1.3	.39	.06
NIP	12	42%	69%	33%	8%	.9	.58	.08
All Sites	47	45%	49%	26%	4%	1.0	.51	0.04

Cumulative Watershed Effects

Landowner representatives were asked the following question:

> Did timber harvest planning include considerations for watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production?
>
> If yes, what type and level of analysis was carried out (i.e., monitoring, screening, CWE indices, interdisciplinary teams, assessments of changing geomorphic processes or a combination of two or more)?

The following table lists the frequency of CWE assessments that were included in harvest planning:

Ownership Group	Sites Where Landowners Assessed Cumulative Effects
Federal	12 of 12 = 100%
Industrial	15 of 18 = 83%
NIP	2 of 12 = 17%
State	5 of 5 = 100%
All Sites	34 of 47 = 72%

DISCUSSION

Table 4 indicates that 94% of the practices rated were properly applied according to BMP standards. These percentages represent an improvement over all previous audits (see Table 12). The high application compliance percentage demonstrates the strong commitment all ownership groups have for BMPs.

As suggested in Table 8, 11% of the high risk BMPs were not effectively applied, and this resulted in impacts. Table 9 indicates that:

- Forty-five percent (21 out of 47) of the audited sites had no impacts recorded.
- Forty-nine percent of the audited sites (23 out of 47) produced minor/temporary impacts.
- Twenty-six percent (12 out of 47) produced either major/temporary or minor/prolonged impacts.
- Four percent (2 sites) had major/prolonged impacts.

A site could be counted in more than one category.

The most frequent departures and impacts were associated with road drainage. The following list ranks rated BMP practices by the sum of departures and impacts. So Practice III.C.1 is ranked #1 because it had more departures and impacts than any other practice. An (--) indicates departures and impacts were not frequent enough to be in the top list for that year.

Practice #	BMP Description	1998	1996	1994	1992	1990	Ave. Rank
III. C. 1 *	Provide adequate road surface drainage for all roads	1	1	1	3	1	1.4
III. C. 6 *	Route road drainage through adequate filtration zones before entering a stream	2	7	2	2	3	3.2
III. E. 2 *	Maintain erosion control features (dips, ditches and culverts functional).	3	5	5	--	10	4.6
III. C. 4	Provide energy dissipaters at drainage structure outlets where needed.	4	14	11	--	--	5.8
V. B. 1b	Direct road drainage away from stream crossing site.	5	3	3	13	19	8.6
III. D. 2 *	Stabilize erodible soils (i.e., seeding, benching, mulching).	6	8	8	15	4	8.2
V. C. 3	Proper sizing for crossing structures.	6	--	--	--	--	1.2
III. C. 2	Skew ditch relief culverts.	8	10	--	--	--	3.6
V. C. 2	Culverts conform to natural streambed and slope.	8	--	10	—	—	3.6
III. A. 4	Locations avoid high hazard sites (i.e., wet areas and unstable slopes).	10	--	15	--	--	5.0
III. D. 5	Cut and fill slopes at stable angle.	10	6	--	12	--	5.6

* Indicates "High Risk" BMP's.

The top three BMP's on the above list, all considered "high risk", accounted for 44% of all departures and impacts. Of 46 practices rated, 21 had zero departures or impacts.

All practices listed above accounted for 79% of all departures and 80% of all impacts. Fourteen of the remaining BMPs had 5 or less departures plus impacts. One of the high risk BMPs, "Design and Locate Skid Trails to Avoid Concentrating Runoff," did not receive any downgrades.

Audit team members noted a range of water quality impacts not associated with any audited timber sale. Both grazing and mining impacts were observed at several audit sites. Some road erosion problems were the result of other land uses such as residential subdivisions.

Results by Ownership Group

All ownerships scored better than a 90% rating for application of rated practices with a weighted average of 94% (see Table 4). This is an outstanding achievement. Rankings for application of BMPs were as follows:

1. DNRC
2. Industrial Lands (IND)
3. Non-Industrial Private (NIP)
4. Federal Lands (FED).

In BMP effectiveness, the rankings were as follows:

1. DNRC ranked first with an unprecedented 99%.
2. NIP
3. IND and FED tied.

Across all rated practices the scores for effectiveness were 95% and above, with a weighted average of 96%. See Table 7.

Comparison with Previous Audits

The 1998 audits are directly comparable to the 1990, 1992, 1994 and 1996 audits. The same selection criteria and rating format were used. Most audit team members had participated in the previous audits. Earlier audits, conducted in 1988 and 1989, were similar, but had differences in design and format.

The 1998 audits show overall improvement in the application and effectiveness of BMPs when compared with previous results. See Table 12 for a comparison of the 1990 through 1998 results.

Table 10
Comparison of BMP Audit Results: 1998 vs. 1996, 1994, 1992 and 1990

	1998	1996	1994	1992	1990
Application of Practices that Meet or Exceed BMP Requirements	94%	92%	91%	87%	78%
Application of High Risk Practices that Meet or Exceed BMP Requirements	84%	81%	79%	72%	53%
Number of Sites with At Least One Major Departure in BMP Application.	8 of 47 (17%)	12 of 44 (27%)	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average Number of Departures in BMP Application, Per Site.	2.0	3.0	3.9	5.6	9
Number of Practices Providing Adequate Protection	96%	94%	93%	90%	80%
Number of High Risk Practices Providing Adequate Protection.	89%	86%	83%	77%	58%
Number of Sites Having at Least One Major Temporary or Minor Prolonged Impact	12 of 47 (26%)	15 of 44 (34%)	13 of 46 (28%)	17 of 46 (37%)	28 of 44 (64%)
Average Number of Impacts Per Site	1.5	2.3	3	4.6	8

All ownership groups showed improvements, though there were some fluctuations in the number of departures and impacts. **Non-industrial private lands again showed the most improvement in both application and effectiveness.**

	1998	1996	1990
NIP BMP Application Rating:	94%	86%	61%
NIP BMP Effectiveness:	96%	89%	65%

This is a dramatic improvement.

Federal sites showed a minor decrease in application but an increase in effectiveness of practices rated in 1998. Federal lands showed no change in the percentage of sites with minor departures and a slight increase in sites with major departures. However, the number of impacts either remained unchanged from 1996 or decreased. There were no gross neglect departures or major/prolonged impacts on Federal sites.

Industrial lands continued to show improvement in application and a minor decrease in effectiveness. This change may be due to the increase in sample size, but even with the decrease in effectiveness their overall rating was still 95%. Seven of the industrial sites had major/temporary or minor/prolonged impacts in 1998. There was only one departure rated gross neglect and one major/prolonged impacts.

DNRC lands showed no change in the percentage of practices rated with minor departures and a decrease in minor/temporary impacts in 1998. DNRC lands again earned the highest ratings

for both application and effectiveness: 96% and 99% respectively. DNRC was the only ownership group that had no major departures or major/temporary, minor/prolonged impacts.

Figure 4 displays BMP application results of the 1990-1998 BMP audits.

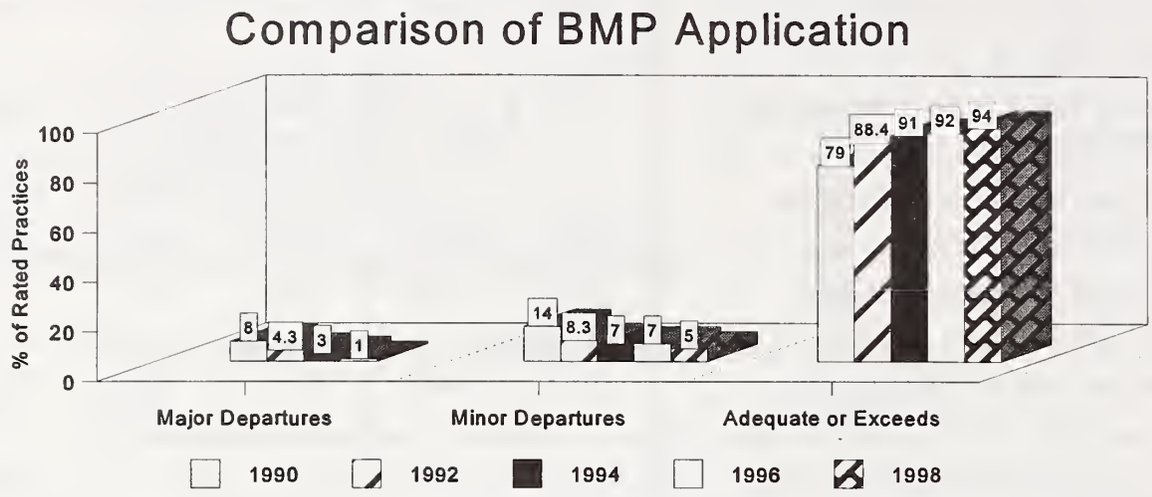


Figure 4
Major Departures Are Practices with an Application Rating <3.
Minor Departures Are Practices with an Application Rating of 3.
Adequate or Exceeds Are Practices with an Application Rating >3.

Figure 5 displays BMP effectiveness results of the 1990-1998 BMP audits.

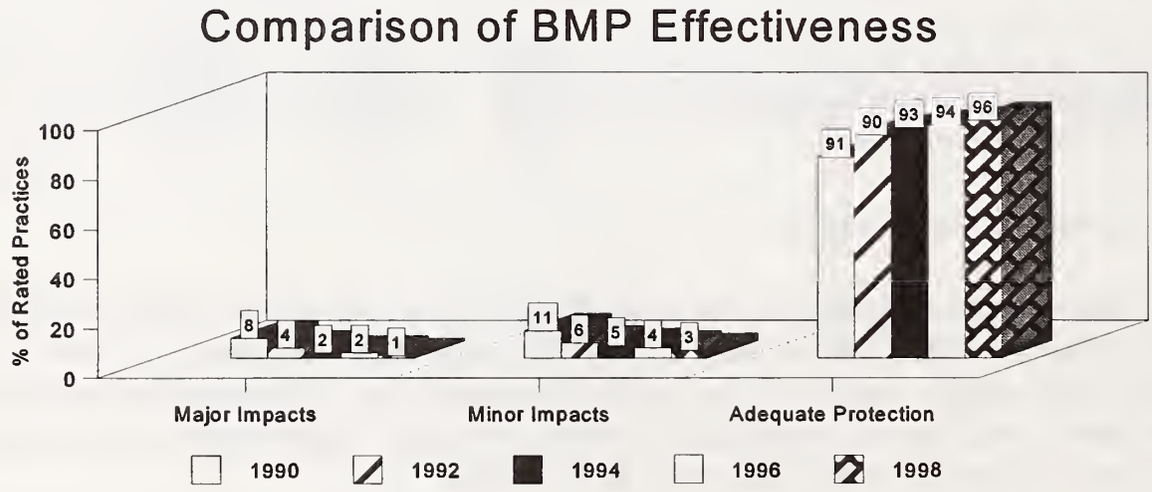


Figure 5
Major Impacts Are Practices with an Effectiveness Rating <3.
Minor Impacts Are Practices with an Effectiveness Rating of 3.
Adequate Protection Is a Practice with an Effectiveness Rating >3.

Figure 6 shows steady improvement in that, through time, fewer and fewer sites have major departures or impacts.

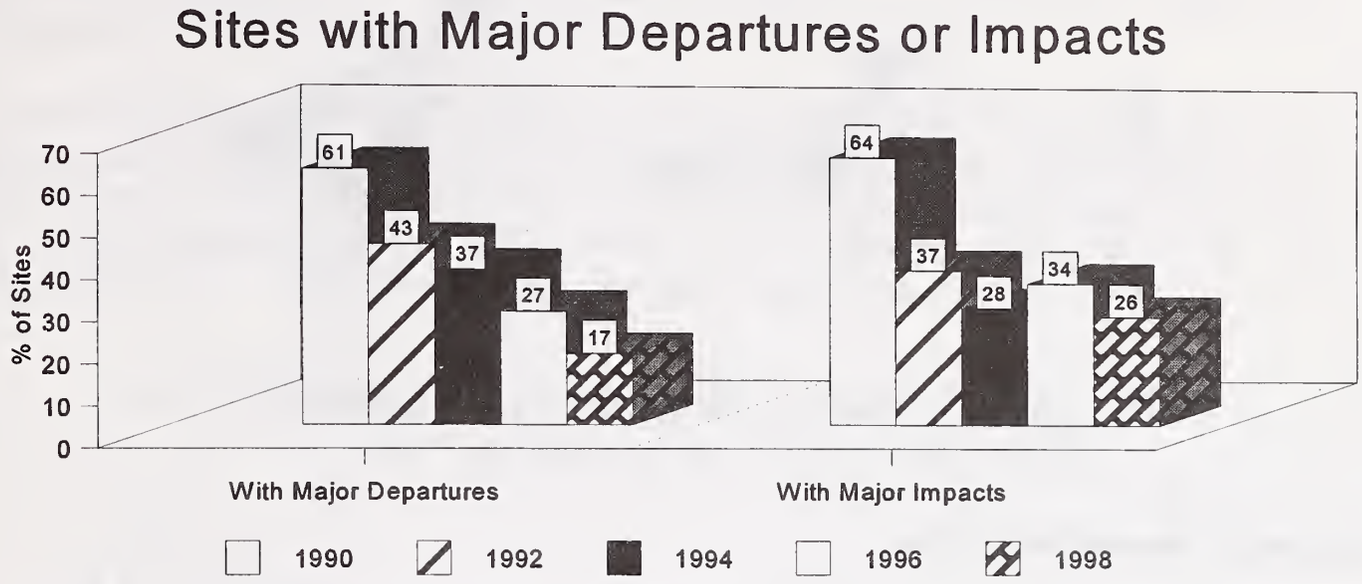


Figure 6
Major Departures Are Practices with an Application Rating of 1 or 2.
Major Impacts Are Practices with an Effectiveness Rating of 1 or 2.

The 1998 audits had fewer major departures and impacts per site than the previous audits. Figures 7 and 8 show the average number of impacts and departures per site.

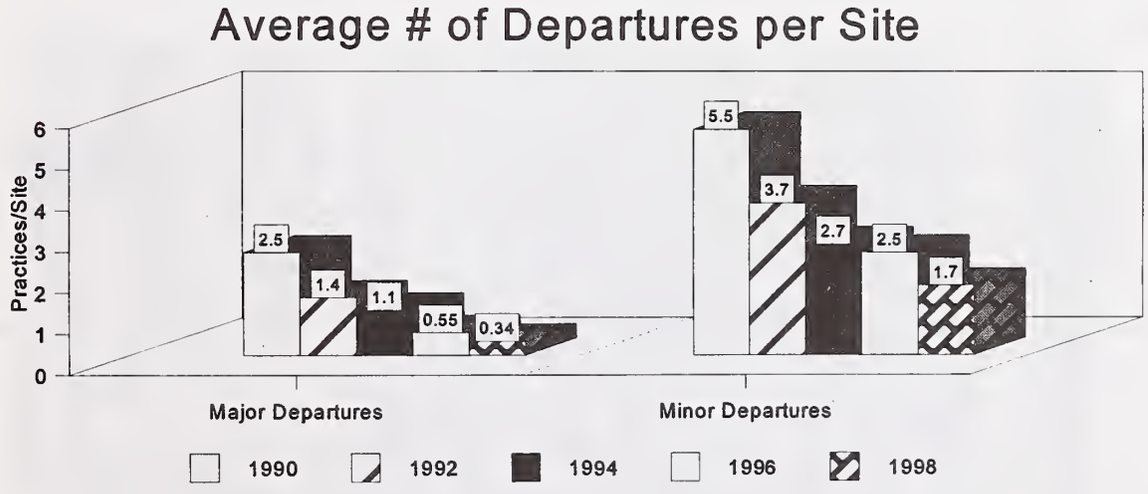


Figure 7
Major Departures are Practices with an Application Rating <3.
Minor Departures are Practices with an Application Rating of 3.

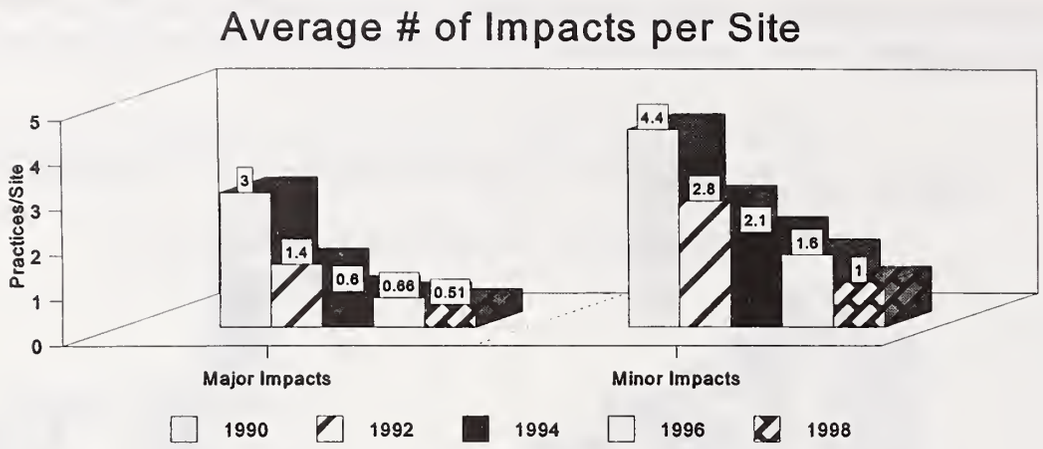


Figure 8
Major Impacts Are Practices with an Effectiveness Rating of <3.
Minor Impacts Are Practices with an Effectiveness Rating of 3.

Streamside Management Zones

The same SMZ rating form was used in 1998 as was used in the 1996 audits, with some minor revisions. A total of ten practices were rated in 1998, one more than in 1996. The first practice dealing with the SMZ width was broken into two practices, one for the actual width and one for marking the SMZ. The practices rated were all taken from the SMZ rules. The same 5-point rating scale used for the 46 BMP questions was used to rate the SMZ rules. **These ratings did not constitute an investigation or initiate any DNRC enforcement action.** Audit team members evaluated departures based on their best professional judgment. The 1996 and 1998 audits were the first two audit cycles where a valid comparison of SMZ results could be made.

Photo #8. Northwest Audit Team Evaluating SMZ

The SMZ law and rules applied to 46 sites. One site was not evaluated because the team determined that the natural drainage feature did not meet the definition of a stream. Harvest of trees within riparian areas (not necessarily the SMZ) occurred on 22 of the 47 sites. Two pre-approved alternative practices, as allowed under the SMZ Rules, and three DNRC-approved, site-specific alternative practices were utilized on five of the sites evaluated.

A total of 15 SMZ departures were noted on 12 sites. There were only two minor sidecasting impacts caused by these departures. The results are very encouraging. SMZ departures were down considerably from the 1996 results, with the greatest improvement coming on NIP sites. The other ownership groups improved or held steady relative to their sample size. (See Figure 9 and Table 11.)

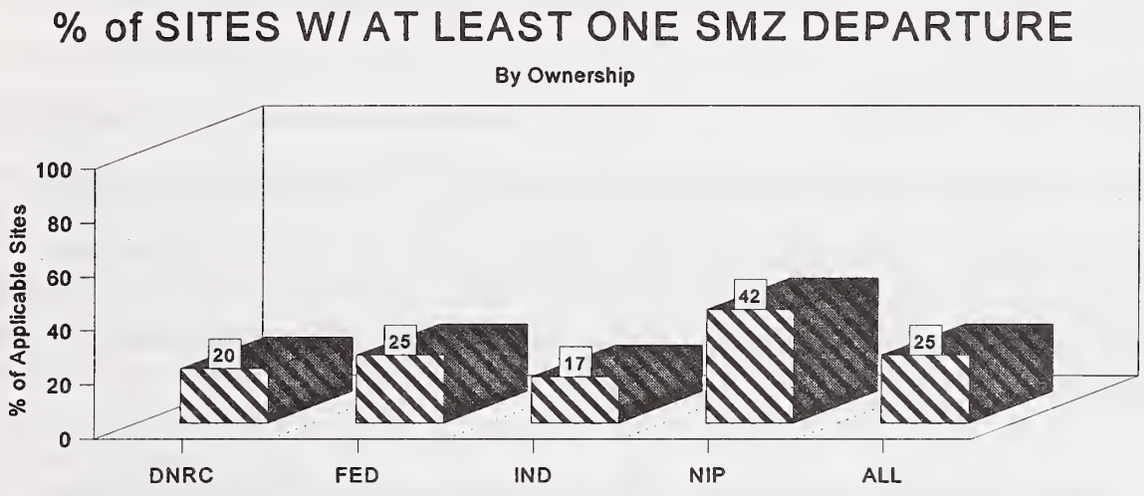


Figure 9

Table 11
SMZ Departures by Ownership Group

Ownership Group	Number of Sites Evaluated		Number of Sites With Departures		Total Number of Departures	
	1996	1998	1996	1998	1996	1998
DNRC	5	5	2	1	2	2
Federal	12	11	4	3	6	3
Industrial	13	18	2	3	2	3
NIP	12	12	10	5	19	7
All Sites	42	46	18	12	29	15

Once again, improperly maintaining and marking the SMZ was the most common departure and occurred on 8 of the sites. Other departures of concern were equipment operation in the SMZ and sidecasting. Retention tree departures and slash deposition had one departure each, down considerably from the 1996 results. Table 12 summarizes and compares SMZ departures by practice.

Table 12
SMZ Departures by Practice

Practice	# Departures	
	1996	1998
Broadcast Burning in SMZ	1	0
Equipment Operation in SMZ	7	3
Clearcutting/Retention Tree Requirements	3	1
Sidecasting into Stream	3	2
Slash Deposited into Stream	5	1
SMZ Maintained/Properly Marked	10	8
Total	29	15

Incorrect SMZ boundary delineation was judged to be a factor in contributing to three departures at three separate sites. However, since SMZ departures were noted on four sites with properly located and marked SMZ boundaries, improper SMZ delineations alone cannot be considered the sole cause of other departures.

Photo #9. Skid Trail

REAUDITS

INTRODUCTION

Governor Racicot's Bull Trout Restoration Team asked if BMPs are effective over time. Responding to this, audits were done on eleven sites previously audited in 1994 or 1996. The audits were designed to answer two basic questions:

1. Are Forestry BMPs effective over time in minimizing erosion and the delivery of fine sediments to fish-bearing streams? If not,

2. Which BMPs need technical modification to effectively control the delivery of fine sediments?

METHODS

A site selection and evaluation process was derived by a working group of diverse interests. They decided to evaluate only high-risk BMPs that had the greatest potential for fine sediment delivery to streams. Thus, special attention was given to stream crossings and other high-risk features. The teams also evaluated compliance with the 1991 Montana Stream Protection Act (SMZ Law and Rules) to establish if stream functions had been protected. All four audit teams conducted one or more reaudits. The rating form used is shown as Appendix G. SMZ functions evaluated included:

1. To act as an effective sediment filter to maintain water quality;

2. To provide shade to regulate stream temperature;

3. To support diverse and productive aquatic and terrestrial riparian habitats;

4. To protect stream channel and banks;

5. To provide large, woody debris that is eventually recruited into a stream to maintain riffles, pools, and other elements of channel structure; and

6. To promote floodplain stability.

Only sites that were rated as high hazard (highly erodible soils or harvest in riparian areas) and that had received a rating of 3 or better for application and effectiveness were considered. Of all possible sites identified, 10 were selected. Finally sites selected were based on proximity to the 1998 audit sites.

RESULTS

Results were interpreted in a two-fold format:

1. A case study of each long-term effectiveness audit site, including a narrative comparison between the original audit results, from either 1994 or 1996, and

2. The observed condition in 1998.

Heavy and sustained spring runoff events were experienced during 1996 and 1997, providing a unique opportunity to observe the efficacy of forestry BMPs under abnormally adverse conditions. Timber harvest sites evaluated included:

- Six sites from Industry,
- Three DNRC sites, and
- Two Federal sites.

CASE STUDIES

IND 2 - Ashley Mountain - Evaluated by the Northwest Audit Team

Date Audited: 1996 Audit Team: Northwest

Previous BMP Departures: Culvert installation at a stream crossing that resulted in no sediment delivery to either the stream/floodplain or the ephemeral system.

Soil Type: Deep calcareous till, medium soil erodibility.

Observations:

When the 1998 audit team evaluated the two stream-crossing culverts, they noted two problems that had developed from the severe runoff events. The first was a rolling drain dip that filled in with fine sediment and was no longer draining the road surface. The result was sediment delivery down the road for approximately 400 feet and fine sediment delivery to the culvert fill. This was noted as a major and temporary impact. This could easily be corrected by applying regular road maintenance. It could have been avoided altogether with a raised culvert fill and better vertical curve alignment directing road drainage away from the crossing. The second problem was in-channel scouring at the culvert outlets, probably from the heavy spring runoff of 1997. This could be corrected by adding in-stream energy dissipaters at the culvert outlets. The SMZ evaluation showed that all six of the SMZ functions were preserved and that none of the reserve trees had blown down.

IND 4 - West Rand - Evaluated by the Northwest Audit Team

Date Audited: 1996 Audit Team: Northwest

Previous BMP Departures: Minor problem at the stream crossing where a minor amount of fine sediment had been delivered to the slash filter windrow, and was perched to deliver to the stream. However, sediment had not reached the stream.

Soil Type: Derived from argillite and glacial till; moderate erodibility rating.

Observations:

As with the Ashley Mountain site, West Rand had suffered the same heavy and sustained spring runoff. However, the 1998 audit team did not find any fine sediment delivery problems anywhere on the site. The minor problem associated with the aforementioned slash filter windrow was no longer evident because of the successful stream crossing and road surface seeding. Travel is restricted on this road with a locked gate. Revegetation of the road and harvest units was excellent.

The team evaluated SMZ harvesting by an intermittent stream and Rand Creek below the West Rand harvest site. This evaluation showed that all six SMZ functions were preserved and that no SMZ windthrow had occurred.

IND 12 - Carrigan Camp - Evaluated by the Northwest Audit Team

Date Audited: 1996 Audit Team: Northwest

Previous BMP Departures: Minor BMP application departure concerning two stream crossing sites with no rolling drain dips. No sediment delivery was found.

Soil Type: Deep, cobbly, silty loam with volcanic ash surface derived from glacial till parent material; medium erodibility.

Observations:

During the winter of 1996-1997, record snowfall caused an unusually heavy and sustained spring runoff. The audit team found that the high-energy flows had eroded part of the culvert fill within the stream channel. A combination of an undersized culvert, skewed alignment, and inadequate armoring contributed to this in-channel erosion. The culvert has since been replaced with a larger pipe and increased fill armoring. As noted with the Ashley Mountain site, solutions to this sort of problem could include the design consideration for arch-type culverts, or larger round culverts, to accommodate larger peak flows. All six SMZ functions were preserved, and no SMZ windthrow had occurred.

IND 8 - Pearson Green - Evaluated by the West Audit Team

Date Audited: 1996 Audit Team: West

Previous BMP Departures: A lack of sufficient drain dips in one location resulted in no sediment delivery. Lack of slash filter windrows at a second stream crossing had resulted in sediment delivery to an ephemeral system.

Soil Type: Derived from argillitte; low erodibility rating.

Observations:

The audit team found problems with the road surface drainage where two rolling drain dips had been overtopped during runoff events, with resulting sediment delivery to an ephemeral stream. The same scenario was noted at the stream crossing where ineffective road surface drainage had led to sediment delivery. These road drainage problems could be corrected with regular maintenance and adding extra rolling drain dips. The team's evaluation of the SMZ showed that all six of the SMZ functions were preserved with good thermal cover, woody debris recruitment and bank protection.

IND 11 - Johnson Tractor/ Line - Evaluated by the West Audit Team

Date Audited: 1994 Audit Team: West Central

Previous BMP Departures: Inadequate road surface drainage and inadequate filtration zones for road drainage. Interestingly, the team rated each of these BMP's as a 3,3 even though their notes indicated that no sediment delivery had occurred - they noted that there was substantial risk of delivery at the stream crossing.

Soil Type: A colluvium derived from quartzite and argillitte; low erodibility rating.

Observations:

The audit team found there were long road distances without drain dips, but no sediment delivery was occurring. They did not find any long-term BMP effectiveness problems site. However, road drainage does flow towards the stream crossings because of the vertical curve alignment, but an excellent filtration zone of vegetation prevented delivery. All six of the SMZ functions were preserved with good shade, adequate in-stream debris, adequate filtration and no blowdown.

IND 7 - Morrell Mountain - Evaluated by the West Audit Team

Date Audited: 1994 Audit Team: West Central

Previous BMP Departures: One minor BMP departure was noted regarding adequate drainage for skid trails and one major BMP departure where skidding on steep slopes had resulted in soil displacement on the steeper skid trails - a 2,2. This 2,2 score would indicate that the team noted either Minor and Prolonged or Major and Temporary impacts, though there was no mention of sediment delivery.

Soil Type: Originating from Belt series geology; low erodibility rating.

Observations:

The team did not find any sediment delivery, but noted minor sidecutting at a stream crossing culvert inlet that had been controlled with good armoring. They also noted slight outfall erosion, resulting in a small scour pool. Fish would be able to navigate the culvert during high flows, but that an arch culvert would have provided better fish passage. All six of the SMZ functions were preserved, and there was good shade, woody debris, adequate filtration, and a minimal amount of spruce blowdown.

DNRC 1 - Six-Mile - Evaluated by the West Audit Team

Date Audited: 1994 Audit Team: West Central

Previous BMP Departures: One minor BMP problem where road use during wet weather had led to some minor rutting; no impacts were noted.

Soil Type: Derived from argillite; low erodibility.

Observations:

The audit team found no significant BMP problems and no sediment delivery. Some of the stream-crossing culvert fill had eroded at the top of the pipe, suggesting that there had been a blockage or other culvert problem. This could have been caused by the 1997 run-off. Vertical curve alignment could have been improved at the stream crossings, or that additional rolling drain dips could have been installed above the crossings to augment the existing road surface drainage. All six of the SMZ functions were preserved, and no windthrow had occurred in the SMZ.

DSL 4 - Deerhorn Unit 6 - Evaluated by the Northwest Audit Team

Date Audited: 1994 Audit Team: West Central

Previous BMP Departures: Three BMP problems noted. The first was a minor problem with road maintenance where road maintenance operations had undercut a small portion of the cutslope--no sediment delivery was noted as a result of this action. The second and third were BMP problems related to the stream crossings where a lack of slash filter windrows and adequate road surface drainage had resulted in sediment delivery to the ephemeral draw, but not to the stream.

Soil Type: Colluvium with a volcanic ash surface derived from quartzite and argillitte parent material; low soil erodibility.

Observations:

The audit team found problems with the road surface drainage at the bridge. The road drain dips at the crossing were so close to the bridge that filtration zones were not sufficient to prevent the delivery of sediment to the stream, even though the dips were well constructed. The filtration zones have been augmented with straw bales, but these are now saturated and ineffective. To correct this problem, road drainage should be directed away from the stream crossing by adding fill and re-grading of the vertical curve alignment of the bridge approaches. All six of the SMZ functions were preserved, and no windthrow had occurred in the SMZ.

DNRC 2 - Tom Miner - Evaluated by the Central Audit Team

Date Audited: 1996 Audit Team: West/East

Previous BMP Departures: One minor BMP application departure noted at the stream crossing where the addition of a more aggressive rolling drain dip would have ensured long-term road surface drainage. No sediment delivery was noted.

Soil Type: Igneous volcanic mudflows; medium erodibility rating.

Observations:

The team found no BMP problems. The stream crossing culverts had been removed with no erosion evident. The stream channels had been restored to a pre-project condition. All six of the SMZ functions were preserved, and a minor amount of windthrow had occurred in the SMZ.

FED 5 - Mill Lion II - Evaluated by the East Audit Team

Date Audited: 1994 Audit Team: West/East

Previous BMP Departures: Several problems noted regarding road surface drainage for all roads where a minor amount of sediment had been delivered to the ephemeral system. Other problems were noted at the stream crossing, specifically road drainage at the crossing where sediment delivery to the ephemeral system had occurred, and both erosion of the culvert fills and in-channel erosion were occurring as a result of poor stream crossing design and installation. The stream crossing design and installation were hampered by the retention of a large spruce tree that was in the way.

Soil Type: Tertiary clayey alluvium from soft/hard sediments; medium soil erodibility.

Observations:

When the 1998 team evaluated the site, they noted that the road surface drainage problem had been fixed by maintenance actions, but the stream crossing problems were still evident. The team noted that the water was piping under the culvert by the now-dead spruce tree, and both side cut and outfall erosion was occurring in the stream channel. Additionally, turbulence erosion was occurring to the culvert fill as a result of the tree and the culvert alignment. All of these problems could have been avoided by the removal of the spruce tree during the original road construction project. All six of the SMZ functions were preserved, and no SMZ windthrow had occurred.

FED 3 - Treasure Mountain - Evaluated by the Central Audit Team

Date Audited: 1994 Audit Team: West/East

Previous BMP Departures: None noted.

Soil Type: Granitic; high erodibility.

Observations:

Despite highly erosive soil, no BMP problems were found except an isolated instance of gully erosion that was caused by dozer piling, but not as a result of pile burning. Sediment was delivered to the ephemeral system. Revegetation of the site will fix this problem. All six of the SMZ functions were preserved, and no windthrow had occurred in the SMZ.

DISCUSSION

The BMP effectiveness evaluations reveal these positive points:

1. The SMZ Law & Rules appear to be as effective in preserving stream condition and function now as when they were originally harvested.

2. Hillslope erosion within harvest units was not evident.

3. Revegetation of harvested areas, skid trails and landings plays a major role in long-term erosion control.

4. No sediment delivery to streams was observed in the harvest units.

5. BMPs are effective over time when properly designed and implemented.

The evaluation has also revealed some very important findings regarding stream crossings:

1. When designed and constructed according to BMP guidelines, few problems occur.

2. Well-designed and constructed crossings can survive unusually heavy runoff events.

Stream Crossing Improvements:

The following problems need to be addressed regarding proper BMP design and construction of stream crossings and attendant road surface drainage.

1. Road drainage features are critical above stream crossings. Drainage features have to be able to survive heavy runoff events at these locations.

2. Filtration zones need to be large enough to dissipate energy and prevent sediment from entering a stream. This requires better location and design of road drainage features at stream crossings.

3. Road alignment at stream crossings should be designed to direct road drainage away from the stream crossing site.

4. Culvert and bridge fills need to be well armored to help survive severe runoff events.

5. Culvert sizing and alignment are critical to prevent in-stream erosion and fill erosion, and to provide for fish passage.

Recommendations from 1998 Audit Team Members

Audit team leaders, team members and the audit working group met on October 15, 1998, and discussed the audits just completed. Others who could not attend submitted verbal or written comments in advance. The recommendations that follow are preliminary outcomes of that meeting. The BMP audit working group will meet this winter and make final recommendations to continue to make the audits as beneficial as possible.

- Continue conducting interdisciplinary forestry BMP audits every two years -- keep the process "non-regulatory".
- Continue to evaluate implementation of the SMZ law and rules.
- Refine the process and form used to audit previously audited sites.
- Continue to encourage audit site landowner, logger and others to attend the audits.
- Continue to make the process as positive and non-threatening as possible.
- DNRC should commit to designing an audit process that is timely, accurate and efficient. Areas for improvement include: solicitation of team members and audit site information; site selection process; and the timeliness of landowner and team notification of audits.
- Revisit the 2-week limit on notification of audit sites
- Continue a separate calibration training for east & west side teams. Calibration training improvements needed include: strictly regimented field trip; training on doing the re-audits; and perhaps separated procedural training for new team members. Team leaders should attend both training sessions.
- Clarify BMP and audit terminology for more consistent audit interpretations and ratings.
- BMP practices should not be rated when features constructed by the audited party have been altered by a third party.
- Encourage development and use of BMPs, and BMP audits for other land uses. (Not part of October 15th meeting discussion)
- Direct education and persuasion toward BMP practices and/or ownership groups that have the greatest opportunity for improvement.
- Secure a permanent source of funding for the audits.

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APPENDIX A

BMP AUDIT TEAM MEMBERSHIP

FISHERIES

NORTHWEST	WEST	CENTRAL	EAST
Scott Rumsey, DFWP +	Dennis Workman, DFWP-RET +	Don Skaar, DFWP +	Mike Poore, DFWP
(Tom Weaver, DFWP) +	(Chris Clancey, DFWP) + #	Jim Brammer, DFWP +	Joel Tohtz, DFWP
(Don Hair, DFWP) +	(Don Peters, DFWP) + #	(Michael Enk, USFS) +	(Michael Enk, USFS) +
(Mike Hensler, DFWP)			

HYDROLOGY

NORTHWEST	WEST	CENTRAL	EAST
Steve Johnson, USFS +	George Mathieus, DNRC +	Steve Hayes, PCTC + [*]	Bo Stuart, USFS +
(Brian Sudgen, PCTC) + #	(Gary Frank, DNRC) +	(John Wittingham, BLM) #	(Mark Nienow, USFS)

SOILS

NORTHWEST	WEST	CENTRAL	EAST
Vito Ciliberti, BLM + [*]	Tim Wiersum, NRCS + *	John Hamann, USFS	Hal Hunter, NRCS-RET + [*]
(Bill Basko, USFS) +	(Skip Barndt, USFS) + [*]	Bob Logar, NRCS +	(Bob Logar, NRCS) +
		(Jeff Collins, DNRC) +	

FORESTRY

NORTHWEST	WEST	CENTRAL	EAST
Russ Hudson, PVT + *	Dick Wick, PCTC +	Rick Franke, SC + *	Gordy Sanders, PML + *
(Larry Coryell, USFS) + #	(Paul Davis, PCTC) + #	(Steve Flynn, LP) +	(Jim Mountjoy, SC) + #
		(Daron Duncan, SC)	

ENGINEERING & ROADS

NORTHWEST	WEST	CENTRAL	EAST
Vic Andersen, PCTC +	Jim Saurbier, USFS +	Bob Korb, USFS	Mike Montgomery, BLM
(Ron Buentemeier, Stoltz) + #	(Earl Applekamp, USFS) +	(Sherman Anderson, PVT) + #	
	(Floyd McCubbins, PVT) + #		

CONSERVATION

NORTHWEST	WEST	CENTRAL	EAST
Dan Paschke, TU +	Bob Benson, CFC +	O'Brien Hollow, MEIC	Judi Brawer, Amer. Wild.
Rod Ash, Audubon Soc. +	(Sady Babcock, MCD) #	(Neysa King, TU) #	(Kim Davitt, Amer. Wild.)
	(Jim Brown, USFS-RET) #		

NON-INDUSTRIAL PRIVATE FOREST LANDOWNER/LOGGER

NORTHWEST	WEST	CENTRAL	EAST
Stuart Crismore, MLA	Fred Hodgboom, MFOA	Russ Gregory, MFOA	Brent Anderson, MLA
(Pat Kearney, MLA)	Thorn Liechty, MFOA +	(Peter Kolb, MFOA)	Bill Kelly, MLA
	Tom Jones, MFOA	(Norm MacPhee, MFOA) #	

+ Denotes Past Audit Experience
* Denotes Team Leader
[*] Denotes Alternate Team Leader
( ) Denotes Alternate Team Member or 2nd Alternate
Not Needed in 1998

APPENDIX B

1998 BMP FIELD AUDITS
RISK RATING GUIDE

MONTANA "RISK" MATRIX (3/91)

TYPE		CLEAR-CUT				PARTIAL CUT				SITE PREP			ROADS	
SLOPE	SOIL EROD.	TERQAUCIKPED	RSUKBIBDER	PSAURSTPIAL	FSUULLSP	TERQUACIKPED	RSUKIBDBER	PSUSPARTIAL	FSUULSLP	MACHINE	PILE/SCAR	BRDCAST	BURN	OTHER	PERM	TEMP
0-5%	H	2	2	2	1	2**	2**	1	1	2	1	1			2**	3
	M	2	1	1	1**	2	1**	1	1	2**	1	1			1	1
	L	1	1	1	1	1	1	1	1	2	1	1			1	1
5-20%	H	4	3	2	1	4*	3	2	1	4	2	1			3	4
	M	3	2	1	1	3*	2	1	1	3	2	1			2	3
	L	2	2	1	1	2*	2*	1	1	2	1	1			2	2
20-40%	H	5	5	4*	2	5*	5*	3**	1	5	3**	1			4	5
	M	4*	4	3	1	3	3	2	1	4	3	1			3	4*
	L	3*	2	2	1	2	2	2	1	3	2	1			3*	3
>40%	H	5	5	4	2	5	5	4	2	5	4	1			5	5
	M	5	5	4	2*	5	5	3	1	5	4	1			5	5
	L	4	4	3	1	4	4	2	1	4	3*	1			4	4

(* Indicates Mean Value Used, ** Final Group Consensus Adjustment for Internal Consistency)

MONTANA EROSION-IMPACT MATRIX

From: "Management Guidelines for Riparian Forests" by Robert Pfister and Kim Sherwood. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program.

LEGEND

1 = LOW RISK 2-3 = MODERATE RISK 4-5 = HIGH RISK

SOIL ERODIBILITY

HIGH ERODIBILITY	MODERATE ERODIBILITY	LOW ERODIBILITY
GRANITICS	SCHIST	ARGILLITE/QUARTZITE
ALLUVIUM	SOFT/HARD SEDIMENTS	METAMORPHIC (BELT)
LACUSTRINE	BASIC IGNEOUS	

HIGH RISK DUE TO RIPARIAN HARVEST

"HIGH" risk will be assigned to sales with logging in riparian zones along streams. Riparian zones are located between aquatic and terrestrial environments are identified by distinct vegetation that requires or tolerates free or unbound water. This includes but is not limited to the following habitat types: ABLA/CACA, (all phases), ABLA/APHO, PICEA/EQAR, THPL/OPHO.

APPENDIX C

DS-49
Rev 6/98

BMP FIELD AUDITS
SITE INFORMATION

Site Number: _____ Meets Selection Criteria: _____
High Hazard: _____

Site Name: _____

Owner: _____

Legal Description: _____ County: _____

Primary Drainage: _____ Month/Year Harvested: _____

Stream Within 200 Ft.? Y / N Name: _____ Bankfull Width: _____

Unit Size: _____ Volume Removed: _____

Road Construction: _____ Length: _____

Road Reconstruction: _____ Length: _____

Slash Disposal Complete: _____ Method: _____

Logging Method: _____

Slope: 0-5% ____; 5-20% ____; 20-40% ____; 40%+ _____

Parent Material: _____

Soil Erodibility: High ___ Medium ___ Low ___

Harvest in Riparian: Y / N

Stream Class:

Comments:

FIELD AUDIT

Date: _____

Team Leader/Recorder: _____

Team Members: _____

_____

Observers Present:

Rating Guide

APPLICATION
5--OPERATION EXCEEDS REQUIREMENTS OF BMP
4--OPERATION MEETS REQUIREMENTS OF BMP
3--MINOR DEPARTURE FROM BMP
2--MAJOR DEPARTURE FROM BMP
1--GROSS NEGLECT OF BMP

EFFECTIVENESS
5--IMPROVED PROTECTION OF SOIL AND WATER RESOURCES OVER PRE-PROJECT CONDITION
4--ADEQUATE PROTECTION OF SOIL AND WATER RESOURCES
3--MINOR AND TEMPORARY IMPACTS ON SOIL & WATER RESOURCES
2--MAJOR AND TEMPORARY OR MINOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.
1--MAJOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.

DEFINITIONS (BY EXAMPLE):
ADEQUATE--SMALL AMOUNT OF MATERIAL ERODED; MATERIAL DOES NOT REACH DRAWS, CHANNELS, OR FLOODPLAIN.
MINOR--EROSION AND DELIVERY OF MATERIAL TO DRAWS BUT NOT STREAM.
MAJOR--EROSION AND SUBSEQUENT DELIVERY OF SEDIMENT TO STREAM OR ANNUAL FLOODPLAIN.
TEMPORARY--IMPACTS LASTING ONE YEAR OR LESS; NO MORE THAN ONE RUNOFF SEASON.
PROLONGED--IMPACTS LASTING MORE THAN ONE YEAR.

NR--NOT REVIEWED NA--NOT APPLICABLE

MONTANA FOREST PRACTICES REVIEW WORKSHEET

BMPs Applicable to:

\+ New Road Construction

\# Existing Roads

▸ Reconstruction

	RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
	SECTION III--ROADS				
	ROAD PLANNING & LOCATION SECTION III.A.				
▸+	1a. MINIMIZE NUMBER OF ROADS NECESSARY. *				
#	1b. USE EXISTING ROADS UNLESS AGGRAVATE EROSION. *				
+	3. AVOID LONG, SUSTAINED, STEEP ROAD GRADES.				
+	4. LOCATIONS AVOID HIGH HAZARD SITES (I.E., WET AREAS AND UNSTABLE SLOPES). *				
+	5a. MINIMIZE NUMBER OF STREAM CROSSINGS. NUMBER _____.				
+	5b. CHOOSE STABLE STREAM CROSSING SITES.				
	ROAD DESIGN SECTION III.B.				
▸+	2. DESIGN ROADS TO MINIMUM STANDARD NECESSARY TO ACCOMMODATE ANTICIPATED USES. *				
+	4. VARY ROAD GRADE TO REDUCE CONCENTRATED DRAINAGE. *				
	DRAINAGE FROM ROAD SURFACE SECTION III.C.				
+▸#	1. PROVIDE ADEQUATE ROAD SURFACE DRAINAGE FOR ALL ROADS. *				
+▸	2. PROTECT, STABILIZE AND SKEW ALL DITCH/RELIEF CULVERTS. *				

	RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
+▸# 4.	PROVIDE ENERGY DISSIPATERS AT DRAINAGE STRUCTURE OUTLETS WHERE NEEDED. *				
+▸# 6.	ROUTE ROAD DRAINAGE THROUGH ADEQUATE FILTRATION ZONES BEFORE ENTERING A STREAM. *				
	CONSTRUCTION/RECONSTRUCTION SECTION III.D.				
+▸ 2.	STABILIZE ERODIBLE SOILS (I.E., SEEDING, BENCHING, MULCHING). *				
+▸ 3.	PROVIDE EFFECTIVE SEDIMENT CONTROL ON ERODIBLE FILL SLOPES.*				
+▸ 5.	CUT AND FILL SLOPES AT STABLE ANGLES. SLOPE RATIO: _____. *				
+▸ 6.	AVOID INCORPORATING WOODY DEBRIS IN ROAD FILL.				
+▸ 8.	EXCESS MATERIALS (WASTE) PLACED IN LOCATIONS THAT AVOID ENTERING STREAM.				
+▸ 9.	SEDIMENT FROM BORROW PITS AND GRAVEL PITS MINIMIZED.				
▸ 10.	RECONSTRUCT ONLY TO THE EXTENT NECESSARY TO PROVIDE ADEQUATE DRAINAGE AND SAFETY. *				
	ROAD MAINTENANCE SECTION III.E.				
+▸# 1.	GRADE ROADS AS NECESSARY TO MAINTAIN DRAINAGE. *				
+▸# 2.	MAINTAIN EROSION CONTROL FEATURES (DIPS, DITCHES AND CULVERTS FUNCTIONAL).				
# 3.	AVOID CUTTING THE TOE OF CUT SLOPES. *				
+▸# 6.	AVOID USE OF ROADS DURING WET PERIODS AND SPRING BREAKUP. *				
+▸# 8.	ABANDONED ROADS IN CONDITION TO PROVIDE ADEQUATE DRAINAGE WITHOUT FURTHER MAINTENANCE.				

SECTION IV--TIMBER HARVESTING

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
HARVEST DESIGN SECTION IV.A.				
2. SUITABLE LOGGING SYSTEM FOR TOPOGRAPHY, SOIL TYPE AND SEASON OF OPERATION.				
5. DESIGN AND LOCATE SKID TRAILS TO AVOID CONCENTRATING RUNOFF.				
6. SUITABLE LOCATION, SIZE, AND NUMBER OF LANDINGS.				
OTHER HARVESTING ACTIVITIES SECTION IV.B.				
1a. SKIDDING OPERATION MINIMIZES SOIL COMPACTION AND DISPLACEMENT.				
1b. AVOID TRACTOR SKIDDING ON UNSTABLE SLOPES AND SLOPES THAT EXCEED 40% UNLESS NOT CAUSING EXCESSIVE EROSION. *				
4. ADEQUATE DRAINAGE FOR LANDING				
5. ADEQUATE DRAINAGE FOR SKID TRAILS.				
SLASH TREATMENT AND SITE PREPARATION SECTION IV.C.				
2. PILE SLASH SO AS TO PRESERVE THE SURFACE SOIL HORIZON. *.				
4. SCARIFY ONLY TO THE EXTENT NECESSARY TO MEET RESOURCE MANAGEMENT OBJECTIVE. *				
5. ACTIVITIES LIMITED TO FROZEN OR DRY CONDITIONS TO MINIMIZE SOIL COMPACTION AND DISPLACEMENT.				
6. EQUIPMENT OPERATIONS ON SUITABLE SLOPES ONLY.				
8. LIMIT WATER QUALITY IMPACT OF PRESCRIBED FIRE. *				
SECTION V--STREAM CROSSINGS				
LEGAL REQUIREMENTS SECTION V.A.				
▸+ 1. PROPER PERMITS FOR STREAM CROSSINGS.				

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
DESIGN CONSIDERATIONS SECTION V.B.				
▸+ 1a. CROSS STREAMS AT RIGHT ANGLES, IF PRACTICAL. *				
▸+ 1b. DIRECT ROAD DRAINAGE AWAY FROM STREAM CROSSING SITE. *				
▸+ 2. AVOID UNIMPROVED STREAM CROSSINGS.				
INSTALLATION OF STREAM CROSSINGS SECTION V.C.				
▸+ 1. MINIMIZE STREAM CHANNEL DISTURBANCE.				
▸+ 2. CULVERTS CONFORM TO NATURAL STREAMBED AND SLOPE. *				
▸+ 3. PROPER SIZING FOR CROSSING STRUCTURES.				
▸+ 4. PREVENT EROSION OF CULVERT AND BRIDGE FILLS (I.E., ARMOR INLET AND OUTLET. *				
▸+ 6. MINIMUM COVER FOR CULVERTS PROVIDED. *				
SECTION VII--HAZARDOUS SUBSTANCE				
GENERAL				
1. ADEQUATE STORAGE AND DISPOSAL FOR FUEL,SHOP DEBRIS,AND WASTE OIL.				

DID TIMBER HARVEST PLANNING INCLUDE CONSIDERATIONS FOR WATERSHED CONDITION AND CUMULATIVE EFFECTS OF MULTIPLE TIMBER MANAGEMENT ACTIVITIES ON WATER YIELD AND SEDIMENT PRODUCTION? **Y / N**	IF SO, HOW?

ADDITIONAL COMMENTS:

STREAMSIDE MANAGEMENT ZONE SITE INFORMATION

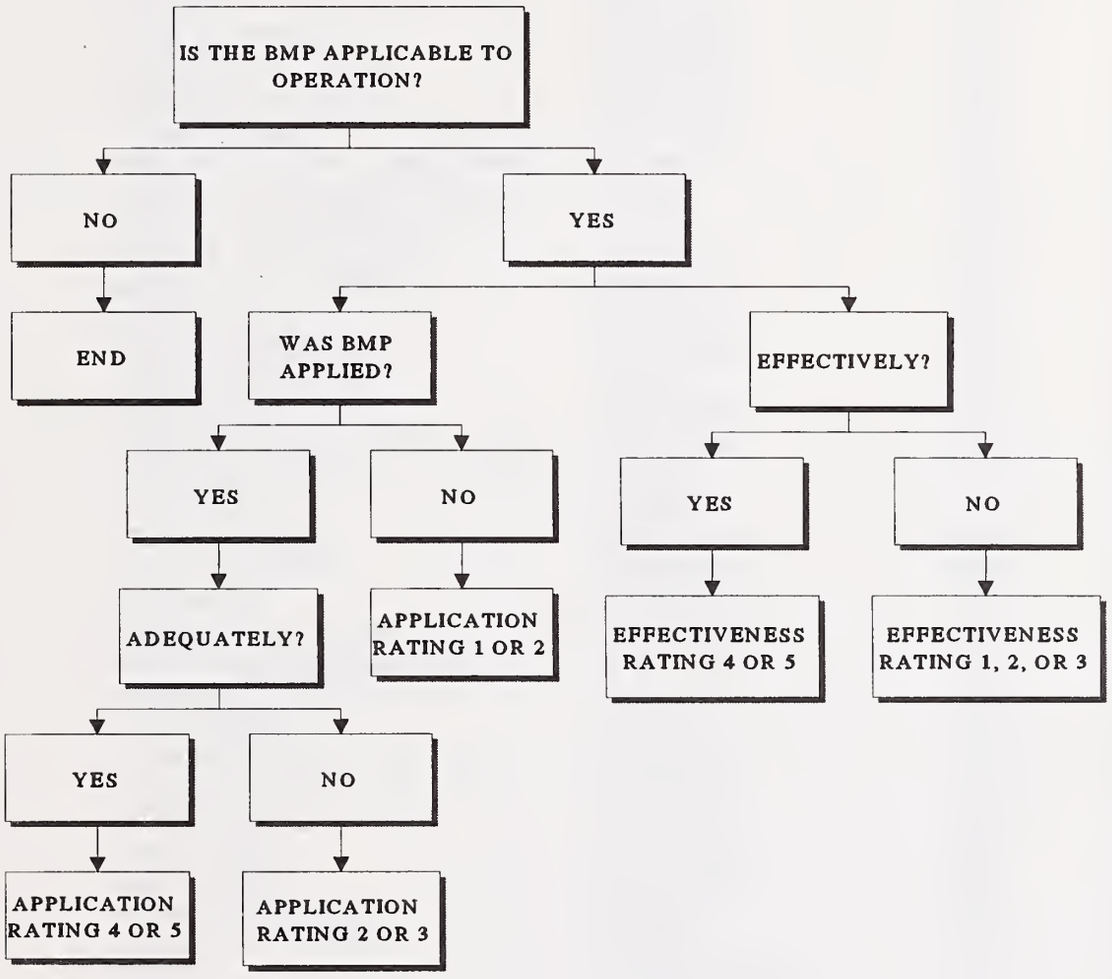
WERE ANY PRE-APPROVED ALTERNATIVE PRACTICES UTILIZED? (* DENOTES PRACTICES THAT APPLY.)	Y / N (LIST APPLIED PRACTICES)
WERE ANY DNRC-APPROVED SITE-SPECIFIC ALTERNATIVE PRACTICES IMPLEMENTED IN THE HARVEST ACTIVITIES?	Y / N (LIST APPLIED PRACTICES)

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
1.a ADEQUATE SMZ WIDTH MAINTAINED, AVG. WIDTH _____				
1.b SMZ PROPERLY MARKED?				
2. EXCLUSION OF BROADCAST BURNING IN SMZ.				
3. SMZ RETENTION TREE REQUIREMENTS MET. (# OF TREES, REPRESENTATIVE OF PRE-HARVEST STAND, FAVOR BANK-EDGE AND LEANING TREES, SHRUBS AND SUBMERCHANTABLE)				
4. EXCLUSION OF EQUIPMENT OPERATION IN SMZ EXCEPT ON ESTABLISHED ROADS.*				
5. EXCLUDE CONSTRUCTION OF ROADS IN THE SMZ EXCEPT WHEN NECESSARY TO CROSS A STREAM OR WETLAND.*				
6. EXCLUSION OF ROAD FILL MATERIAL DEPOSITED IN SMZ EXCEPT AS NEEDED TO CONSTRUCT CROSSINGS.				
7. EXCLUSION OF SIDE-CASTING OF ROAD MATERIAL INTO A STREAM, LAKE, WETLAND OR OTHER BODY OF WATER DURING ROAD MAINTENANCE.				
8. EXCLUSION OF SLASH IN STREAMS, LAKES OR OTHER BODIES OF WATER.				
9. EXCLUDE THE HANDLING, STORAGE, APPLICATION OR DISPOSAL OF HAZARDOUS OR TOXIC MATERIALS IN THE SMZ IN A MANNER THAT POLLUTES OR CAUSES DAMAGE OR INJURY.				

ADDITIONAL COMMENTS:

APPENDIX D

RATIONALE FOR THE RATING SYSTEM
POST HARVEST EVALUATION



APPENDIX E

1998 BMP FIELD AUDITS
SITES PICKED FOR AUDITS BY OWNERSHIP GROUP

SITE #	SITE NAME	COUNTY	OWNER	TEAM
DNRC-1	2% TIMBER SALE	RAVALLI	DNRC	WE
DNRC-2	BELT PARK	CASCADE	DNRC	EA
DNRC-3	JEFF MED	BEAVERHEAD	DNRC	CE
DNRC-4	HOODOO TIMBER SALE	LINCOLN	DNRC	NW
DNRC-5	CHEADLE	FERGUS	DNRC	EA
FED-1	BUCK LITTLE BOULDER	RAVALLI	USFS	WE
FED-2	HASKILL	FLATHEAD	USFS	NW
FED-3	LAVA MOUNTAIN	JEFFERSON	USFS	CE
FED-4	MOOSE PARK UNIT #2	MEAGHER	USFS	EA
FED-5	BIG WOLF SALVAGE	FLATHEAD	USFS	NW
FED-6	INDIAN CREEK	POWELL	BLM	WE
FED-7	TOLL MOUNTAIN ASPEN UNIT 1	JEFFERSON	USFS	CE
FED-8	HUNGER HENRY SALVAGE	LAKE	USFS	NW
FED-9	UPPER MILL UNIT 23	PARK	USFS	CE
FED-10	CHINA BASIN SALVAGE	LINCOLN	USFS	NW
FED-11	MARSHALL COOPER	MISSOULA	USFS	WE
FED-12	BORDER PEAK	SANDERS	USFS	NW
IND-1	SICKLER OVERLOOK	FLATHEAD	PCTC	NW
IND-2	MULLAN IT OVER	POWELL	PCTC	CE
IND-3	BENTON LINE GULCH II	MEAGHER	BSL	EA
IND-4	HERR EAST - TRACTOR & LINE	FLATHEAD	PCTC	NW
IND-5	TAKES THE CAKE	POWELL	PCTC	WE
IND-6	BLACK CAT	POWELL	PCTC	WE
IND-7	ABOVE EXPO PULP	FLATHEAD	STLZ	NW
IND-8	COYOTE FOREST	MISSOULA	PCTC	WE
IND-9	RUGER CAT	MISSOULA	PCTC	WE
IND-10	WHEELER SEC 3 LINE	GALLATIN	BSL	CE
IND-11	WEST FORK WILSON LINE	GALLATIN	BSL	CE
IND-12	FLESHMAN CREEK	PARK	BSL	CE
IND-13	FELIX CREEK	LINCOLN	PCTC	NW
IND-14	BAYWATCH SALVAGE LINE	LINCOLN	PCTC	NW
IND-15	LET JOE ADAM	MINERAL	PCTC	WE
IND-16	WEST FORK PETTY LINE	MINERAL	PCTC	WE
IND-17	UPPER BUTT	GALLATIN	BSL	CE
IND-18	FAIRY CREEK	GALLATIN	BSL	CE
NIP-1	ATHERTON CREEK	FERGUS	PVT	EA
NIP-2	MCCARTNEY CREEK	FERGUS	PVT	EA
NIP-3	EAST 14	MUSSELSHELL	PVT	EA
NIP-4	BIG TIMBER CREEK	SWEETGRASS	PVT	EA
NIP-5	BLACKFOOT BOTTOM	POWELL	PVT	WE
NIP-6	COW CREEK	CARBON	PVT	EA
NIP-7	WEST SHEEP CREEK	ROSEBUD	PVT	EA
NIP-8	DIAMOND R CREEK	CUSTER	PVT	EA
NIP-9	HOOVER CREEK	POWELL	PVT	WE
NIP-10	SOUTH FORK STICKNEY CREEK	LEWIS & CLARK	PVT	CE
NIP-11	SLUSHMAN CREEK	GALLATIN	PVT	CE
NIP-12	LOGAN CREEK	FLATHEAD	PVT	NW

APPENDIX F

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
ROAD PLANNING													
Minimize #	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
of Roads	FED	0	0	0	11	0	1	0	0	0	11	0	1
III.A.1a	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	10	0	2	0	0	0	10	0	2
	Total:	0	0	0	44	0	3	0	0	0	44	0	3
Use Existing	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
Roads	FED	0	0	0	12	0	0	0	0	0	12	0	0
III.A.1b	IND	0	0	0	14	0	4	0	0	0	14	0	4
	NIP	0	0	0	11	0	1	0	0	0	11	0	1
	Total:	0	0	0	41	0	6	0	0	0	41	0	6
Avoid Long,	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Steep Grades	FED	0	0	0	5	0	7	0	0	0	5	0	7
III.A.3	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	10	0	2	0	0	0	10	0	2
	Total:	0	0	0	38	0	9	0	0	0	38	0	9
Avoid High	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Hazard Areas	FED	0	1	0	4	0	7	0	1	0	4	0	7
III.A.4	IND	1	0	0	16	0	1	0	1	0	16	0	1
	NIP	0	0	1	9	0	2	0	0	1	9	0	2
	Total:	1	1	1	34	0	10	0	2	1	34	0	10
Minimize # of	DNRC	0	0	0	4	0	0	0	0	0	4	0	0
Stream X'ings	FED	0	0	0	4	0	8	0	0	0	4	0	8
III.A.5a	IND	0	0	0	13	0	5	0	0	0	13	0	5
	NIP	0	0	0	4	0	8	0	0	0	4	0	8
	Total:	0	0	0	25	0	21	0	0	0	25	0	21
Choose	DNRC	0	0	0	5	0	1	0	0	0	5	0	1
Stable Stream	FED	0	0	0	3	0	9	0	0	0	3	0	9
Crossing Sites	IND	0	0	0	8	0	10	0	0	0	8	0	10
III.A.5b	NIP	0	0	0	4	0	8	0	0	0	4	0	8
	Total:	0	0	0	20	0	28	0	0	0	20	0	28

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
ROAD DESIGN													
Minimum Design Standards III.B.2	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	11	0	1	0	0	0	11	0	1
	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	10	0	2	0	0	0	10	0	2
	Total:	0	0	0	44	0	3	0	0	0	44	0	3
Vary Grade for Drainage III.B.4	DNRC	0	0	0	4	0	0	0	0	0	5	0	0
	FED	0	0	0	6	0	6	0	0	0	6	0	6
	IND	0	0	1	16	0	1	0	0	1	16	0	1
	NIP	0	0	0	9	0	3	0	0	0	9	0	3
	Total:	0	0	1	35	0	10	0	0	1	36	0	10
ROAD DRAINAGE													
Adequate Surface Drainage III.C.1	DNRC	0	0	2	2	1	0	0	0	0	5	0	0
	FED	0	1	6	5	0	0	0	1	2	9	0	0
	IND	0	0	5	13	0	0	0	0	4	14	0	0
	NIP	0	1	5	5	0	1	0	2	0	9	0	1
	Total:	0	2	18	25	1	1	0	3	6	37	0	1
Skew Relief Culverts III.C.2	DNRC	0	0	0	2	0	3	0	0	0	2	0	3
	FED	0	0	2	5	0	5	0	0	1	6	0	5
	IND	0	0	2	7	0	9	0	0	2	7	0	9
	NIP	0	0	0	0	0	12	0	0	0	0	0	12
	Total:	0	0	4	14	0	29	0	0	3	15	0	29
Energy Dissip. at CMP Outlets III.C.4	DNRC	0	0	1	4	0	0	0	0	1	4	0	0
	FED	0	0	2	10	0	0	0	0	2	10	0	0
	IND	0	1	1	16	0	0	0	1	1	16	0	0
	NIP	0	0	0	7	0	5	0	0	0	7	0	5
	Total:	0	1	4	37	0	5	0	1	4	37	0	5
Route Drainage Through SMZ III.C.6	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	4	1	7	0	0	0	5	0	7	0	0
	IND	0	1	5	11	0	1	0	2	3	12	0	1
	NIP	0	1	1	10	0	1	0	1	1	10	0	1
	Total:	0	6	7	33	0	2	0	8	4	34	0	2

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
ROAD CONSTRUCTION													
Stabilize Erodible Soils III.D.2	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	1	0	10	0	1	0	1	0	10	0	1
	IND	0	0	1	16	0	1	0	1	2	14	0	1
	NIP	0	0	1	9	0	2	0	1	0	9	0	2
	Total:	0	1	2	40	0	4	0	3	2	38	0	4
Sediment Control Erodible Fill Slopes III.D.3	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	1	9	0	2	0	0	1	9	0	2
	IND	0	1	0	16	0	1	0	1	1	15	0	1
	NIP	0	1	0	6	0	6	0	0	0	6	0	6
	Total:	0	2	1	35	0	10	0	1	2	34	0	10
Slopes at Stable Angle III.D.5	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	1	9	0	2	0	0	1	9	0	2
	IND	0	1	1	16	0	0	0	1	1	16	0	0
	NIP	0	0	0	10	0	2	0	0	0	10	0	2
	Total:	0	1	2	39	0	5	0	1	2	39	0	5
Avoid Incorporating Woody Debris in Road Fill III.D.6	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	0	11	0	1	0	0	0	11	0	1
	IND	0	0	1	17	0	0	0	0	0	18	0	0
	NIP	0	0	0	10	0	2	0	0	0	10	0	2
	Total:	0	0	1	42	0	4	0	0	0	43	0	4
Overburden Placement III.D.8	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	1	6	0	5	0	0	0	7	0	5
	IND	0	0	0	14	0	4	0	0	0	14	0	4
	NIP	0	0	2	6	0	4	0	0	2	6	0	4
	Total:	0	0	3	30	0	14	0	0	2	31	0	14
Sediment From Borrow Pits III.D.9	DNRC	0	0	0	1	0	4	0	0	0	1	0	4
	FED	0	0	0	1	0	11	0	0	0	1	0	11
	IND	0	0	0	0	0	18	0	0	0	0	0	18
	NIP	0	0	0	1	0	11	0	0	0	1	0	11
	Total:	0	0	0	3	0	44	0	0	0	3	0	44
Minimize Reconstruction III.D.10	DNRC	0	0	0	3	1	1	0	0	0	4	0	1
	FED	0	0	0	10	0	2	0	0	0	10	0	2
	IND	0	0	0	8	0	10	0	0	0	8	0	10
	NIP	0	0	0	4	0	8	0	0	0	4	0	8
	Total:	0	0	0	25	1	21	0	0	0	26	0	21

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
ROAD MAINTENANCE													
Grade Roads	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
for Drainage	FED	0	0	0	12	0	0	0	0	0	12	0	0
III.E.1	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	11	0	1	0	0	0	11	0	1
	Total:	0	0	0	46	0	1	0	0	0	46	0	1
Erosion Control	DNRC	0	0	1	4	0	0	0	0	0	5	0	0
Functional	FED	0	0	4	8	0	0	0	1	1	10	0	0
III.E.2	IND	0	0	6	12	0	0	0	0	4	14	0	0
	NIP	0	1	1	8	0	2	0	1	1	8	0	2
	Total:	0	1	12	32	0	2	0	2	6	37	0	2
Avoid Cutting	DNRC	0	0	0	4	0	0	0	0	0	4	0	1
Slope Toe	FED	0	0	1	11	0	0	0	0	1	11	0	0
III.E.3	IND	0	0	0	16	0	0	0	0	0	16	0	2
	NIP	0	0	0	11	0	1	0	0	0	11	0	1
	Total:	0	0	1	42	0	1	0	0	1	42	0	4
Restrict Use	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
When Wet	FED	0	0	0	12	0	0	0	0	0	12	0	0
III.E.6	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	11	0	1	0	0	0	11	0	1
	Total:	0	0	0	46	0	1	0	0	0	46	0	1
Adequate Drain.	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
on Aband. Roads	FED	0	0	1	2	2	7	0	0	0	4	1	7
III.E.8	IND	0	0	0	6	0	12	0	0	0	6	0	12
	NIP	0	0	1	6	0	5	0	1	0	6	0	5
	Total:	0	0	2	18	2	25	0	1	0	20	1	25
HARVEST DESIGN													
Logging Suits	DNRC	0	0	0	5	0	0	0	0	1	4	0	0
Topography	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.A.2	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	11	0	1	0	0	0	12	0	0
	Total:	0	0	0	46	0	1	0	0	1	46	0	0

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Skid Trail	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Design	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.A.5	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	10	0	1	0	0	0	10	0	1
	Total:	0	0	0	45	0	1	0	0	0	45	0	1
Landing Size	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Location	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.A.6	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	11	0	0	0	0	0	11	0	0
	Total:	0	0	0	46	0	0	0	0	0	46	0	0
OTHER HARVEST ACTIVITY													
Skid to Min.	DNRC	0	0	1	4	0	0	0	0	1	4	0	0
Displacing Soil	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.B.1a	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	1	11	0	0	0	0	1	11	0	0
	Total:	0	0	2	45	0	0	0	0	2	45	0	0
Skid to Min.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Compacting Soil	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.B.1b	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	11	0	1	0	0	1	11	0	1
	Total:	0	0	0	46	0	1	0	0	1	46	0	1
Adequate Drain.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
for Landings	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.B.4	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	12	0	0	0	0	0	12	0	0
	Total:	0	0	0	47	0	0	0	0	0	47	0	0
Adequate Drain.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
for Skid Trails	FED	0	0	0	12	0	0	0	0	0	12	0	0
IV.B.5	IND	0	0	0	17	0	2	0	0	0	17	0	2
	NIP	0	0	1	10	0	1	0	0	1	10	0	1
	Total:	0	0	1	44	0	3	0	0	1	44	0	3

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
SITE PREPARATION													
Brush Blades	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Used	FED	0	0	0	11	0	1	0	0	0	11	0	1
IV.C.2	IND	0	0	0	17	0	1	0	0	0	17	0	1
	NIP	0	0	1	11	0	0	0	0	1	11	0	0
	Total:	0	0	1	44	0	2	0	0	1	44	0	2
Scarify Only	DNRC	0	0	0	4	0	0	0	0	0	5	0	0
to Extent	FED	0	0	1	10	0	2	0	0	0	10	0	2
Necessary	IND	0	0	0	16	0	2	0	0	0	16	0	2
IV.C.4	NIP	0	0	0	12	0	0	0	0	1	12	0	0
	Total:	0	0	1	42	0	4	0	0	1	43	0	4
Compaction and	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Displacement	FED	0	0	0	11	0	1	0	0	0	11	0	1
Minimized	IND	0	0	0	16	0	2	0	0	0	16	0	2
IV.C.5	NIP	0	0	0	12	0	0	0	0	0	12	0	0
	Total:	0	0	0	44	0	3	0	0	0	44	0	3
Equipment	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Operation	FED	0	0	0	12	0	0	0	0	0	12	0	0
On Suitable	IND	0	0	0	17	0	1	0	0	0	17	0	1
Slopes Only	NIP	0	0	0	11	0	1	0	0	0	11	0	1
IV.C.6	Total:	0	0	0	45	0	2	0	0	0	45	0	2
Limit WQ Impact	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
of Fire	FED	0	0	0	8	0	4	0	0	0	8	0	4
IV.C.8	IND	0	0	1	15	0	2	0	0	0	16	0	2
	NIP	0	0	0	11	0	1	0	0	0	11	0	1
	Total:	0	0	1	39	0	7	0	0	0	40	0	7
STREAM CROSSINGS													
Proper Permit	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
Obtained	FED	0	0	0	5	0	7	0	0	0	5	0	7
V.A.1	IND	0	0	0	9	0	9	0	0	0	9	0	9
	NIP	0	0	0	4	0	8	0	0	0	4	0	8
	Total:	0	0	0	21	0	26	0	0	0	21	0	26

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
STREAM XING DESIGN													
Cross Stream	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
at Right Angle	FED	0	0	0	7	0	5	0	0	0	7	0	5
V.B.1a	IND	0	0	0	9	0	9	0	0	0	9	0	9
	NIP	0	0	0	6	0	6	0	0	0	6	0	6
	Total:	0	0	0	26	0	21	0	0	0	26	0	21
Direct Drainage	DNRC	0	0	0	3	1	1	0	0	0	4	0	1
Away From	FED	0	1	1	7	0	3	0	1	2	8	0	3
Stream Crossing	IND	0	0	1	9	1	7	1	0	1	9	0	7
V.B.2	NIP	0	0	1	5	0	6	0	0	0	5	0	4
	Total:	0	1	3	24	2	17	1	1	3	26	0	15
Avoid Unimproved	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
Crossings	FED	0	0	0	8	0	4	0	0	0	7	1	4
V.B.2	IND	0	0	0	12	0	6	0	0	0	12	0	6
	NIP	0	0	0	6	1	5	0	0	0	7	0	5
	Total:	0	0	0	30	1	16	0	0	0	30	1	16
STREAM XING INSTALLATION													
Min. Channel	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
Disturbance	FED	0	0	0	7	0	5	0	0	0	7	0	5
V.C.1	IND	0	0	0	9	0	9	0	0	0	9	0	9
	NIP	0	0	1	4	1	6	0	0	0	6	0	6
	Total:	0	0	1	24	1	21	0	0	0	26	0	21
Culverts Conform	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
to Streambed	FED	0	0	2	5	0	5	0	0	1	6	0	5
Slope	IND	0	0	1	7	0	10	0	0	1	7	0	10
V.C.2	NIP	0	0	1	3	0	8	0	0	1	3	0	8
	Total:	0	0	4	19	0	24	0	0	3	20	0	24
Proper Sizing	DNRC	0	0	1	3	0	1	0	0	0	4	0	1
For Crossing	FED	0	0	1	6	0	5	0	0	0	7	0	5
Structures	IND	0	1	0	8	0	9	1	0	0	8	0	9
V.C.3	NIP	0	0	2	3	0	7	0	1	1	3	0	7
	Total:	0	1	4	20	0	22	1	1	1	22	0	22

1998 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Prevent Fill	DNRC	0	0	1	3	0	1	0	0	0	4	0	1
Erosion	FED	0	0	1	6	0	5	0	0	1	6	0	5
V.C.4	IND	0	0	1	8	0	9	0	0	1	8	0	9
	NIP	0	0	0	4	0	8	0	0	0	4	0	8
	Total:	0	0	3	21	0	23	0	0	2	22	0	23
Adequate Cover	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
for Culverts	FED	0	0	0	7	0	5	0	0	0	6	0	5
V.C.6	IND	0	0	0	9	0	9	0	0	0	8	0	9
	NIP	0	0	0	4	0	8	0	0	0	4	0	8
	Total:	0	0	0	24	0	23	0	0	0	22	0	23
HAZARDOUS SUBSTANCES													
Proper Storage	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
and Disposal	FED	0	0	0	12	0	0	0	0	0	12	0	0
VII.1	IND	0	0	0	18	0	0	0	0	0	18	0	0
	NIP	0	0	0	12	0	0	0	0	0	12	0	0
	Total:	0	0	0	47	0	0	0	0	0	47	0	0
GRAND	TOTALS:	0	24	109	1501	7	427	0	29	72	1537	3	427

APPENDIX G

MONTANA FOREST PRACTICES REAUDIT WORKSHEET

BMP CRITERIA **Please denote whether the condition is original or due to maintenance	GRADE ONLY 4,2,1
1. Have road drainage features remained effective in intercepting road surface sediment? *Provide adequate road surface drainage for all roads - III C 1*	
2. In combination with question 1; have filtration zones intercepted road surface sediments at outlet of road drainage features, preventing delivery to draws, stream and annual flood plains? *Route road drainage through adequate filtration zones before entering a stream - III C 6*	
3. Have skid trail water bars and other features remained effective intercepting skid trail sediments? *Adequate drainage for skid trails and fire lines IV B 5*	

	GRADE ONLY 4,2,1
4. In combination with question 3; have filtration zones intercepted skid trail sediments, preventing delivery to draws, streams or annual flood plains?	
5. Is sheet or gully erosion occurring within harvest units as a result of site preparation and slash treatment activities? *Pile slash so as to preserve the surface sol horizon IV C 2* *Scarify only to the extent necessary to meet resource management objective IV C 4* *Activities limited to frozen of dry conditions to minimize soil compaction and displacement IV C 5* *Equipment operations on suitable slopes only IV C 6*	
6. In combination with question 5; have filtration zones intercepted sediments generated by site preparation or slash treatment activities, preventing delivery to draws, streams of annual floodplain?	
7. Has erosion occurred as a result of prescribed fire? *Limit water quality impacts of prescribed fire - IV C 8*	

	GRADE ONLY 4,2,1
8. In combination with question 7; have filtration zones intercepted ashes or sediment generated by prescribed fire, preventing delivery of sediment or ashes to a draw, streams or annual flood plains?	
9. Specifically at stream crossings; have road drainage features remained effective in intercepting road surface sediments? *Direct road drainage away from stream crossing site III C 6*	
10. In combination with question 9; have filtration zones intercepted road surface sediments at the outlets of read drainage features, preventing delivery to draws, streams and annual flood plains? *Route road drainage through adequate filtration zones before entering a stream III C 6*	
11. Are stream crossing culverts producing head cut, side cut or outfall erosion? *Culverts conform to natural stream bed and slope V C 2*	

	GRADE ONLY 4,2,1
12. Are stream crossing culverts, and/or bridges, providing for adequate fish passage? *Culverts conform to natural stream bed and slope V C 2*	
13. Is erosion of bridge or culvert fills occurring? *Prevent erosion of culvert and bridge fills V C 4*	
14. In combination with question 13; have filtration features intercepted bridge and culvert fill erosion and prevented delivery of sediment to streams or annual flood plains? *Slash filter windrows installed III D 3*	
15. Include narrative description of SMZ function and condition:	

2,000 copies of this public document were published at an estimated cost of $1.80 per copy, for a total cost of $3,600.00, which includes $3,600.00 for printing and $.00 for distribution.